THURSDAY, NOVEMBER 19, 1914.

VITALISTIC BIOLOGY.

(1) *The History and Theory of Vitalism.* By Prof. H. Driesch. Authorised translation by C. K. Ogden. Pp. viii+239. (London: Macmillan and Co., Ltd., 1914.) Price 5*s.* net.

(2) *The Philosophy of Biology.* By Dr. J. Johnstone. Pp. xv+391. (Cambridge University Press, 1914.) Price 9*s.* net.

(1) IT is a somewhat melancholy reflection for those who had the pleasure of listening to Prof. Driesch's brilliant lectures on "Vitalism" at King's College last year, that owing to the outbreak of the present war Prof. Driesch may be at this moment engaged in armed conflict with some of his then hearers. Few German men of science had more friends in England than Prof. Driesch, and few had a warmer appreciation of England. One of his very earliest pieces of work was accomplished in the marine station at Plymouth.

In the volume before us Prof. Driesch is dealing not with facts but with the history of the idea of vitalism, the idea, that is to say, that there is at work in organic beings some agency not to be discovered in inorganic things, and that the peculiarities of living matter are not to be explained by its physical and chemical structure, but by an organising "something" within, which continually modifies this structure in order to achieve an "end." Beginning with Aristotle, Driesch recounts for us the views of a series of vitalistic naturalists and philosophers ending and culminating in himself. It would indeed be a perilous undertaking were we to attempt to criticise in detail the account which he gives of the earlier vitalists, among whom are included, not only Aristotle and many of the older naturalists, but Kant, Lotze, and Schopenhauer, and it would have but little interest for the readers of NATURE. The scientific man, as distinguished from the metaphysician, takes only a minor interest in the views of early naturalists, who dealt with imperfectly known and ill-understood data, and still less in those of dealers in abstractions like Kant. Prof. Driesch, with a daring which we can only humbly admire, endeavours to make clear what Kant really meant. Perhaps we may remind him that another German philosopher, Paulsen, has defied anyone to find a rational meaning in a good deal of what Kant wrote, adding that it is only to be explained psychologically as due to the pull of tendencies which dragged Kant's mind now in one direction, now in another.

The book concludes, as we have intimated, with an account of Driesch's own views, but as these are pretty faithfully reproduced in the second volume which we notice in this review, we may defer criticism of them. We should like, however, to protest in the strongest manner against the scornful way in which Driesch refers to Darwin. "Darwin—left the question of variability open, a course which reduced his doctrine to the self-evident proposition that what was not capable of existence could not exist." "Darwinism—explained how, by throwing stones, one could build houses of typical style."

When we contrast the work of Darwin, based on a life-time of study and on the broadest possible survey of the fields of zoology and botany, with that of his critic, which may be described as an inverted pyramid based on myopic concentration on a few facts of development, and contrast, further, the influence which the theories of the two men have had on contemporary thought, we are forced to the conclusion that to Prof. Driesch, as to many of his countrymen, the Lord hath denied a sense of humour.

Darwin, taking for granted the known peculiarities of living beings seen every day around us, and pointing out the result of the impact of the known forces of the environment on these peculiarities, sought to prove that a world something like the present one must result from purely natural causes; he is neither mechanist nor vitalist. Driesch at the close of his book tells that he supposes phylogeny to be a "supra-personal evolution." Which view, we may ask, is more helpful as a working hypothesis?

(2) Mr. Johnstone's book may be perhaps described as a combination of Driesch and Bergson. Its object is to support vitalism, and to combat the mechanistic view of life. Mr. Johnstone, who is a biologist distinguished for his researches into problems of marine biology, has the merit of putting his case in clear, well-written language, and although he has to deal with philosophical problems he avoids philosophical technical terms as much as possible, so that the ordinary reader has little difficulty in following him. On the principle, apparently, that any stick is good enough to beat a dog with, Mr. Johnstone employs arguments of totally different, and somewhat incompatible, kinds to enforce his position. He begins with a chapter entitled "The Conceptual World," which is a statement of the idealistic position, and really assists him not at all. For this position merely affirms the fact, obvious on reflection, that experience as *I* receive it implies at least an *I* who perceives it, and who is as real as the experience. The logical outcome of this, as Driesch has phrased it, is, "The world is

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my phenomenon," so that there must be at least one observer distinguished from what is observed. But in life and practice we all know, though we cannot prove, that there is a similar "*I*" behind many of the objects which we perceive, viz., our fellow men and women. How far there is anything similar to human personality behind the other animals and behind plants he would be a bold man who would say. So far, indeed, as this argument is valid, it is valid against physical science as much as against "mechanistic biology." The idealistic argument is followed by a long chapter, the object of which is to persuade us that there is something very mysterious and unchemical about the synthesis of carbohydrate by chlorophyll in the presence of sunlight.

We then reach the root of the matter, which is the impossibility of explaining on chemical and physical principles the growth of the organism through the embryonic stage from the egg. This, indeed, is the citadel of Driesch's position. We have to try to account for the fact that a portion of an egg or of a blastula of an Echinoderm is capable of giving rise to a whole organism, and Driesch has no difficulty in showing that there is no conceivable machine-like arrangement of parts which will account for this. But, indeed, one has only to read Weismann's hopeless attempts to explain the regeneration of limbs on his "determinant" theory to be convinced of this. The best answer to Driesch is this: "Suppose we admit that we cannot explain these phenomena by physics, what alternative explanation have you to offer?" Of course, we are all familiar with the answer: "Living beings are inhabited by 'entelechia,' which guide their activities towards predetermined ends." But such an answer does not assist us. To put forward an unknown entity as the cause of phenomena which we cannot unravel is not to explain, but in reality to give up the attempt at explanation.

"Materialism," as known to practical biologists, is really only the modest and praiseworthy attempt to penetrate a little into the working of living things by *comparing* the processes which go on in them with chemical processes in inorganic nature. But if everything is due to an entelechy, very many insoluble questions arise. Allied species are believed to be genetically related to one another; how are their different entelechies related? Is there a possibility of entelechies being modified? Or, again, if by inverting a frog's egg in the two-cell stage we can cause it to produce a double-headed monster, how is it that the entelechy is so easily baulked of its purpose? If, however, we assume that there are in eggs *organ-forming substances*—and in some cases we can prove this by direct observation, we may have to admit that these substances are very remarkable and unparalleled in inorganic objects, but at any rate we have hold of a concept with which we can work. For a substance can be divided into two, and it may be evenly distributed throughout an egg as in Echinodermata or localised as in Annelida and Mollusca, and thus we are enabled to understand why a portion of an Echinoderm egg will produce a whole organism, but why a part of a Molluscan egg will only produce a part of an organism.

Other instances of similar hypotheses could be mentioned which assist in binding together the facts observed in the behaviour of living things and in elucidating the laws which govern them. The use of such hypotheses may be regarded as neither vitalistic nor mechanistic, but as plain common-sense applications of the inductive method. In this way, and in this way alone, it seems to us, shall we ever make progress with "explanations" of the phenomena of life, for all "explanation" in the last resort consists merely in putting together similar things. When, however, we have finished with the explanations of Driesch, both as related by himself and as given by his admirer, Mr. Johnstone, we are left in a mental fog—no great guiding principles to bind together vital phenomena emerge, and the conviction grows that whatever be the right method of tackling the phenomena of life it is not that of Driesch. E. W. M.

BRITANNIC GEOGRAPHY.

(1) *The British Empire beyond the Seas: An Introduction to World Geography.* By Dr. Marion I. Newbigin. Pp. xii+351. (London: G. Bell and Sons, Ltd., 1914.) Price 3*s.* 6*d.*

(2) *The British Isles.* By Dr. F. Mort. Pp. xi+231. (Cambridge University Press, 1914.) Price 3*s.*

(3) *Argyllshire and Buteshire.* By P. Macnair. Pp. x+161. (Cambridge University Press, 1914.) Price 1*s.* 6*d.* net.

(4) *Geological Excursions round London.* By G. MacDonald Davies. Pp. vi+156. London: T. Murby and Co., n.d.). Price 3*s.* 6*d.* net.

(1) MISS NEWBIGIN'S work is always lucid, and she brings the facts of geography into a happy correlation. The continental shelf of North America is thus connected (p. 110) with the accumulation of the Newfoundland Banks, and through them with the cod-fisheries. The size of Australian sheep-farms (p. 147) is explained by the peculiarities of the

rainfall. The climate of Cyprus is first discussed (p. 35) on account of its contrast with that of Mongonui in New Zealand. The world-wide view of phenomena is never absent, and a pupil who reads these pages will cease to regard the British Empire as so many isolated red patches on a map.

The various divisions of the Empire are arranged according to their climatic conditions. British Columbia is thus treated, as having a "maritime temperate climate," apart from Canada east of the Rockies, which "may be more justly compared with eastern Europe and temperate Asia." Agriculture and forestry are properly regarded as the fundamental industries that depend on climate, and many interesting statements are made as to the modes in which labour-difficulties have been met. The questions and exercises encourage further reading; we are, for instance, asked to consider the right food for our coolies, and what we should sell, as Egyptian peasants, in order to pay our taxes. We have noticed only one tiny slip; the question on p. 333, "Why do you think the islanders rejoice so greatly when this worm appears?" does not quite express the meaning of the author.

(2) Dr. Mort describes the British Isles in the modern manner that now appeals to secondary schools, and his references to the geological structure of the country are sufficient to lead the pupil to ask for more. In later work a school may well use the volume on the geography of its own county provided by the same educational press, and it will be found that Dr. Mort has laid a good foundation for more detailed local study. References to castles and the holding of gaps make us inclined to think that more might be made of the influence of structural features upon British history. No young mind that can appreciate the rise of the industries of Sheffield or of ship-building on the Clyde should remain unmoved at Portnaspania or the Roman Wall. The references to the Devon seamen (p. 133) are admirable. The illustrations are well selected to show varied types of scenery. The scarped plateau of Ben Bulben (Fig. 79) is due to limestone, and not, as is stated, to Millstone Grit.

(3) Mr. Macnair's acquaintance with the geology as well as the antiquities of his country makes him an excellent guide to the mountainous lands of Argyll and Bute. This volume of the Cambridge Geographies is issued with rounded corners, and is thus all the better as a companion for the numerous travellers who start from Glasgow for the sea-lochs and the isles. General considerations are introduced in the earlier pages, and we notice that the author, while laying stress on glacial erosion, points out that the fiords have been developed "along the geological grain of the country," and sometimes across this grain. He does not, however, refer to the probability of the weakening of the land by cross-fractures before the ice-action set in. We are glad to see an Oligocene rather than an Eocene age assigned (p. 22) to the Cainozoic lavas. The account of the geology of Arran is also well brought up to date. In the index to the geological map, however, the word "chalk" should be "Cretaceous"; and should not "ferriferous," on p. 59, be "ferrous"?

The diminution of the highland population through the attraction of other fields is strikingly seen in the fact that Argyll, on the edge of the prosperous Central Valley, has lost 30 per cent. of its population since 1831. The county was long a battle-ground, owing to its position between the lowland and the western isles, and the author well remarks that perhaps the greatest date in its history was the arrival of Columba at Iona in 563.

(4) London remains the home of sincere amateurs in natural history, and the quiet woods and byways on the edges of its basin in these days tempt the walker more and more. Mr. Davies guides us from convenient railway-stations to view-points or famous sections where we may appreciate the structure of the hills. A good coloured geological map is given as a frontispiece, and this handy book should soon become known to London students, and also to visitors from the Continent. G. A. J. C.

NATURE STUDY FOR SCHOOL AND HOME.

(1) *A First Course in Plant and Animal Biology.* By W. S. Furneaux. Pp. viii + 232. (London: University Tutorial Press, Ltd., 1914.) Price 2*s.*

(2) *A First School Botany.* By E. M. Goddard. Pp. xiii + 191. (London: Mills and Boon, Ltd., 1914.) Price 2*s.* 6*d.*

(3) *Pond Problems.* By E. E. Unwin. Pp. xvi + 119. (Cambridge: University Press, 1914.) Price 2*s.* net.

(4) *Wild Life in the Woods and Streams.* By C. A. Palmer. Pp. xv + 206. (London: A. and C. Black, 1914.) Price 3*s.* 6*d.*

(5) *The English Year: Summer.* By W. B. Thomas and A. K. Collett. Pp. viii + 341. (London: T. C. and E. C. Jack, 1914.) Price 10*s.* 6*d.* net.

TO-DAY the junior student of biology has his attention directed to function and behaviour, rather than to those structural features which claimed almost exclusively the interest of

his predecessors of thirty years ago. This modern tendency is shown in the batch of books now before us.

(1) Mr. Furneaux, introducing his lesson-book for school-classes, tells us that his work "deals with living nature rather than with dead objects." Beginning with Amœba and the Yeast, he passes first to plant life, as illustrated by fern and flowering plant, and then to animal life, so far as it can be demonstrated by short lessons on butterfly, frog, pigeon, and a few common mammals. The grosser structure of flowering plants is discussed at some length; in the zoological section attention is directed chiefly to what may be seen by the pupils as they watch the living creatures. Indeed, the anatomical information is almost too meagre to be of use, and the classificatory schemes are faulty; for example, eagles and owls are placed in the same order of birds, while among the mammals the Ruminants are separated ordinally from the Ungulata, which are said to include the horse, ass, and swine! The book concludes with a chapter on human physiology extending to 25 pages. Distinctly useful as the book may prove to an earnest teacher, it leaves the impression of an attempt to include too much in the space allotted.

(2) Miss E. M. Goddard's book, "written to provide a course in elementary botany for the middle forms," and admittedly intended to be "useful to students preparing for examination," gives an excellent combination of practical exercises and clear explanations, illustrated by good, bold outline drawings. The pupil who works conscientiously through the physiological experiments, and laboratory and field observations described in this small volume will have won something better than examination successes—a well-grounded foundation for future study of plant life. On page 46 there is a curious slip of "corm" for "bulb," in a paragraph distinguishing these two favourites of the botanical examiner, which may puzzle the intending examinee.

(3) In "Pond Problems," Mr. E. E. Unwin has produced a noteworthy educational work. He deals only with aquatic insects, and no naturalist who appreciates the mode of treatment adopted will be surprised to find that the method of teaching was learned in the laboratory of Prof. L. C. Miall. Mr. Unwin has, indeed, given his fellow-teachers the benefit of his own lesson-notes. The nature of his method will best be realised from the fact that in 100 pages there are 397 questions, to most of which the pupils are left to find answers from their own observations. All the drawings and most of the photographic illustrations are excellent. Hints are given for the construction of simple but efficient pieces of apparatus, and the boys or girls who are fortunate enough to be taken through the course on the lines indicated will enjoy a "good time." Is it not a mistake to use the term "skin"—even with quotation marks and explanations—for the chitinous exoskeleton of an arthropod? Why not write "cuticle," and thus familiarise the student from the beginning with the essential difference between the secreted envelope and the true skin which forms it?

(4) With Mr. C. A. Palmer's contribution we pass from school-books to a play-book, for he has written a series of bright chatty notes on common animals in the form of letters to a young boy. Many of these are thrown into the anthropomorphic story-sketch which has been popular of late years, both in the United Kingdom and in America. The somewhat slight letterpress is illustrated by attractive drawings. Although the scene of "Dad's" zoological researches is ostensibly an English county, he describes and figures the trap-door nest of a Nemesia, which raises a certain degree of scepticism with regard to his other stories.

(5) Messrs. Thomas and Collett have produced a volume of popular natural history for the drawing-room, which in literary form, typographical finish, and illustrations is "a thing of beauty." The black and white sketches—drawn by Mr. A. W. Seaby—are mostly admirable, and there are some attractive reproductions in colour of notable landscapes, though a plain naturalist, with an old-fashioned preference for clear drawing, is grateful for the printed information that one of them represents "building the Rick"; "Digging out the Sand-pit" would have been equally credible as a title. The book is made up of a series of short chapters describing phases of country life through the months of June, July, and August. Animals and plants are discussed in relation to their surroundings, and the authors see birds and flowers with the artist's eye. The passion for the open so pervades the book that it will surely drive some readers "Along the River" and "Among the Grasses," if not "Below the Tidemark." In some of their explanations the authors are too dogmatic. Our British species of Erebia, for example, are not surviving members of "the Arctic fauna which flourished here in the Ice Age." They both belong to the distinctively Alpine group which is southern rather than northern in its affinity, and neither is to be found in the Arctic regions. The studies of bird and plant life are generally good, and the drawings of birds—at rest or in flight—are excellent, as are most of the plant sketches. In

the chapters devoted to insects, however, there are signs of want of touch between authors and artist. In the chapter on "Butterfly Flight" there is a drawing of a "Fritillary," which represents the plant, not the insect of that name; the "Little Blue resting," on p. 35, appears to have been drawn from a "Common Blue," while the "Female Emperor," on p. 104, is unmistakably *Arctia caia*, the "Common Tiger" moth. Such slips as these can, however, be easily rectified in a new edition. G. H. C.

PRACTICAL DRAWING.

(1) *A Manual of Mechanical Drawing.* By J. H. Dales. Pp. xii+181. (Cambridge University Press, 1914.) Price 3*s.* net.

(2) *Machine Construction and Drawing.* Book ii. By A. E. Ingham. Pp. xii+180. (London: G. Routledge and Sons, Ltd., 1914.) Price 3*s.* net.

THE titles of these two books have been well chosen; in one the chief concern of the author is to ensure manipulative skill in instrumental *drawing*, and in the other to illustrate details of engineering *construction*.

(1) Those readers who take Mr. Dales as their guide will undergo a process of careful drilling in the use and maintenance of the scale, square, pencil, pen, and compass, by means of specially designed and carefully graduated sets of exercises, largely geometrical in character, followed by examples of the projection of various machine details, and completed by the preparation of a full set of working drawings of a screw-cutting lathe, fully dimensioned, with titles and descriptions, all executed in the style of the skilled professional draughtsman. Thus the book gives a course of organised training in the draughtsman's craft, valuable especially to students who afterwards enter a drawing office, for they will be ready to begin elementary design or other good work at once.

(2) Mr. Ingham has previously written an elementary book on the subject, and the present volume is intended as a continuation, suitable for more advanced students. It gives, with descriptions and simple calculations, a large number of well-selected examples representing modern engineering practice, arranged and classified in seven chapters headed respectively, "Power Transmission Appliances," "Gearing," "Steam Engines and Turbines," "Gas and Oil Engines," "Boilers and Fittings," "Machine Tools and Appliances," "Pumps and Compressors." The drawings are well printed and thoroughly workmanlike and have evidently been prepared by a highly qualified expert. The student's progress is tested from time to time by sets of suggestive examples in drawing, calculation, and design. The text-book is a very good example of its kind, and will give satisfaction wherever adopted.

OUR BOOKSHELF.

Essays and Addresses. By the late Prof. James Campbell Brown. Pp. x+208. (London: J. and A. Churchill, 1914.) Price 5*s.* net.

MR. HENRY H. BROWN, who edits this volume, explains in the preface that this selection of essays and addresses has been published because of the many requests for copies of particular papers by the late Prof. Brown which Mrs. Campbell Brown has received but was unable to accede to because most of the essays had never been printed.

The papers are arranged in chronological order, and most of them are concerned with various aspects of pure and applied chemistry. The first, on technical chemistry, was the chairman's address to the Liverpool section of the Society of Chemical Industry, and was delivered in November, 1886. The last essay, on science applied to the detection of crime, was an address to the chemical, physical, and legal societies at the University of Liverpool in 1908. The scope of the volume can be gathered from the titles of some of the other papers: the ethics of chemical manufacture, a French view of German industries, the use and abuse of hypothesis, and chemistry as a profession.

The papers have been printed as nearly as possible in the shape in which they were delivered, and will be welcomed by their author's old pupils and friends, who will recognise many characteristic touches.

The Happy Golfer. Being some Experiences, Reflections, and a few Deductions of a Wandering Player. By H. Leach. Pp. vii+414. (London: Macmillan and Co., Ltd., 1914.) Price 6*s.* net.

THIS is a brightly written book, full of the free air of the links and the sweet philosophy of the man who enjoys the simple life of the natural athlete. The author discovers in golf seven wonders, the fascination that grips, the traditions which never stale in the telling, the ubiquity of the game, St. Andrews the sacred Mecca of every golfing soul, the tragedy of the short putt, the three mighty men who share fifteen open championships among them, and the marvellous amateur eight times champion, and, lastly, the romance of the rubber-cored ball. On these as texts he dilates and prattles, then takes us all round the world searching for happy golfing hunting-grounds, returning finally to the best heaven-given links of the dear homeland. He talks of players and matches, of temperament and style, of courses and hazards. When he touches on what is generally called the science of the game he speaks wisely and not dogmatically. Not a single illustration of stance or grip disturbs the literary glamour of the page; and the mysteries

of the underspin and the dynamics of the slice and the pull are as if they were not. There is no "science" in the book; but it is admirably human.

C. G. K.

A History of the Teaching of Domestic Economy. Written for the Association of Teachers of Domestic Subjects in Great Britain by Ailsa Yoxall. Pp. 58. (London: Knapp, Drewett and Sons, Ltd., n.d.) Price 6*d*.

THIS little book represents the first attempt to place on record an account of the growth of the teaching of domestic economy in Great Britain. The movement appears to have been started in earnest about 1840, when some instruction in needlework began to be given in national schools for girls and infants. From this date to the present time the importance of instruction of this character has been recognised increasingly, until to-day the Association of Teachers in Domestic Subjects includes no fewer than thirteen important local branches, receives direct recognition by the Government, and elects one of its members to represent it on the Registration Council. The subject is now also given a more scientific character and includes a practical and theoretical study of every aspect of housewifery. The book deserves the attention of all who are interested in vocational education for girls.

LETTER TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Newton and the Spectrum.

IN NATURE of November 5, 1914, p. 263, I notice in the Astronomical Column a statement to the effect that, in connection with spectrum analysis, Wollaston (1802) was the first to employ the slit. I therefore venture to send a copy of the following passage, contributed by me to the 1913 Journal of the Leeds Astronomical Society, published last September:—

"Almost all writers, who quote Newton's classical experiment, overlook or ignore the fact that, recognising the impurity of the spectrum formed by admitting the sunlight through a round hole, Newton suggested the use of a linear aperture. Here is the passage from pp. 59–60 of the 4th edition of the *Opticks* (Book I., Prop. IV.):—

"'Yet instead of the Circular Hole, 'tis better to substitute an oblong Hole shaped like a long Parallelogram with its Length parallel to the [refracting edge of the] Prism. For if this Hole be an Inch or two long, and but a tenth or a twentieth Part of an Inch broad, or narrower; the Light of the Image will be as simple as before, or simpler, and the Image will become much broader, and therefore more fit to have Experiments try'd in its Light than before.'

"It is not quite clear whether Newton actually tried this narrow aperture. I think he did; and it is interesting to consider that, if he had sufficiently narrowed the slit, and observed the spectrum directly by the eye, instead of observing it upon a screen, he might have discovered the dark lines."

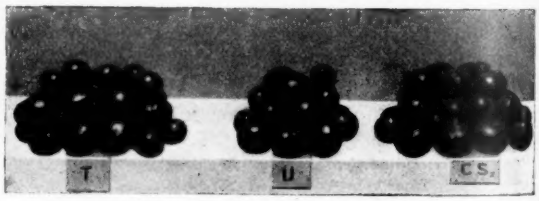
C. T. WHITMELL.

Invermay, Hyde Park, Leeds, November 9.

THE PARTIAL STERILISATION OF SOILS.

THE work to be described in this article arose, as so often happens, out of an accident in the laboratory. The writer was investigating the rate of oxidation of phosphorus, and during the progress of the work was called to take charge of an agricultural laboratory. Before finally disbanding the apparatus some observations were made on soils, and it was found that fertile soils absorbed oxygen more rapidly than non-fertile soils of the same character. Since the action was very considerably reduced in sterilised soils it was concluded that the process is largely due to

Untreated soil. Partially sterilised soils (by toluene). (by heat).



Partially sterilised soil (by toluene). Untreated soil. Partially sterilised soil (by carbon disulphide).

FIG. 1.—Crops grown on untreated and in partially sterilised soils.

the activity of micro-organisms, and the connection between oxygen absorption and fertility was attributed to the large part played by micro-organisms in the production of plant food.

In doing the final confirmatory set of experiments the soils were only sterilised at 100° and not at 130°, in consequence of a mistake which caused some little annoyance at the time. An experiment was, however, carried out with this partially sterilised soil, and it led to the remarkable result that oxygen absorption is more rapid in such soil than in normal untreated soil. Other methods of partial sterilisation gave the same result. In view of the close connection between

oxidation and productiveness, a set of pot experiments was put up, and these showed that the fertility of the soil was also increased after partial sterilisation. Typical results are illustrated in Fig. 1: the upper part gives experiments with rye, the lower part with tomatoes.

At this stage it was found that the fact had been discovered before by practical growers. Soil that had been heated, *e.g.* by a bonfire, or treated with the antiseptic (carbon disulphide) used for destroying certain pests, gave larger crops than before. The fact had even been reported to one or two of the German experiment stations, but it had not attracted very much attention. One important discovery had been made, however: it was found that partial sterilisation caused increases in the numbers of bacteria, and this was explained by supposing that the weaker races had been killed, leaving the more vigorous in clear possession of the field.

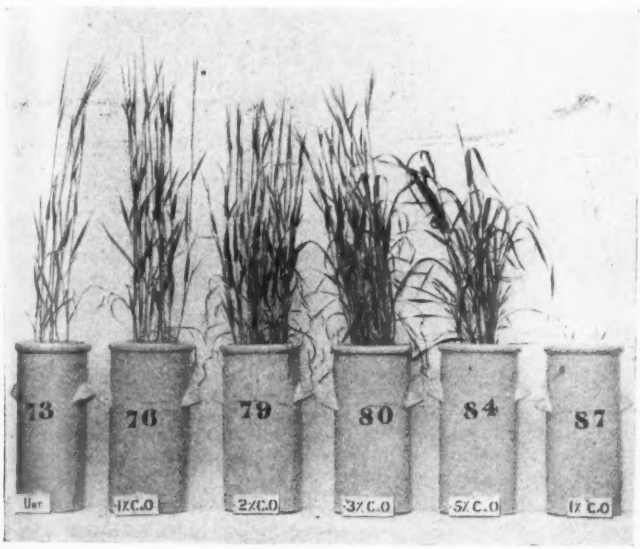


FIG. 2.—Lime as an agent for soil sterilisation. Pot 73, control; 76–87, successively increasing doses; between 79 and 80 lies the partial sterilisation point; 87 contains an excessive amount. (H. B. Hutchinson.)

Systematic investigations at Rothamsted soon showed that the increased productiveness of partially sterilised soils was due to an increased formation of ammonia, and this in turn was traced to the increased numbers of bacteria. The new flora, however, was not composed of more vigorous races as had been supposed; on the contrary, it was less vigorous than the old, and it owed its extra decomposing power to its numerical superiority. This point was established by numerous experiments because of its great importance in explaining the phenomena. The reason for the increased bacterial numbers was traced to a detrimental factor present in normal soils and keeping down the bacterial numbers; this factor was put out of action by partial sterilisation, whereupon the bacterial numbers began to rise. Owing to its highly complex nature soil forms very unpromising material for a direct attack; investigations have nearly always to be indirect. In the present instance the method adopted for discovering the detrimental factor was to ascertain what agencies put it out of action and what did not, and thus to draw up a list of its properties. It was found, for example, that the detrimental factor was sharply put out of action by heating to 55° C., or by any poison, and that it never set up again so long as the soil was kept free from dust; it did, however, appear when a little untreated soil was added, but the reappearance was slow and somewhat erratic. These and other experiments all indicated that the factor was biological; but definite evidence was obtained that it was not bacterial. Suspicion therefore fell on the protozoa, which were found to occur in all the natural soils examined but to be killed by the partial sterilisation. A very large number of experiments showed that the destruction of the soil protozoa always went hand in hand with the increase in bacterial numbers; up to the present no exception has been found. This is strong presumptive evidence, but unexpected difficulties arose when attempts were made to clinch the evidence by inoculating mass cultures of protozoa into partially sterilised soils, and up to the present these have not been overcome. We are, therefore, thrown back on indirect methods.

The first difficulty that was raised against the identification of the detrimental factor with the soil protozoa was that the protozoa were probably present in the soil as cysts, and not in the trophic state. It was argued that the soil conditions must be unfavourable for the development of animals like protozoa, which stand in constant need of air and water. The first investigations seemed to support this view. The copious development of protozoa when untreated soil is inoculated into hay infusion, of course, proves nothing; and when attempts are made to entice anything out of the soil by thermo- or galvanotactic methods nothing happened. The test organism was *Colpoda cucullus*, a ciliate occurring abundantly in the culture and easy to pick out under the microscope, and no evidence could be obtained that it occurred in the trophic state in the soil.

However, the experiments were continued. Mr. Martin found that a film was formed when soil was vigorously shaken with concentrated picric acid solution which, on examination, was seen to contain protozoa. The significance of the observation is, of course, that the acid instantly kills the organisms in the soil, so that the state in

which they are found in the film is the state in which they actually occur in the soil. It was with no little interest, therefore, that the work of the protozoologists was watched, and when they discovered that the amœbæ were in the trophic state, and not all present as cysts, it was felt that a distinct advance had been made. Mr. Lewin has since devised a method of getting the protozoa alive out of the soil. Thus, satisfactory proof is furnished that an active protozoan fauna exists in normal field soils. Some of the organisms are of special zoological interest, and have therefore been studied in detail.

Even yet, however, the problem is not solved, because there is nothing to show how numerous the active protozoa are. Neither Martin's nor Lewin's method is susceptible of quantitative use, and at present the only guide is the ease with which the organisms can be picked out.

however, the main interest of the "sick" soils, *i.e.*, the soils known to be heavily stocked with the detrimental factor, is that they contain numerous active amœbæ, and never fail to give good crops of organisms by either of the methods in use.

On the other hand, the detrimental factor is reduced considerably by drying the soil, especially at high summer temperature. So also the harvest of protozoa becomes very thin in field soils during dry summer weather.

This, therefore, is the present position so far as the identification of the detrimental factor is concerned. There seems no doubt that it is living, and there is strong indirect evidence to connect it with the soil protozoa. But the direct evidence is lacking, partly because the difficulties of introducing mass cultures into partially sterilised soils have not yet been overcome, and

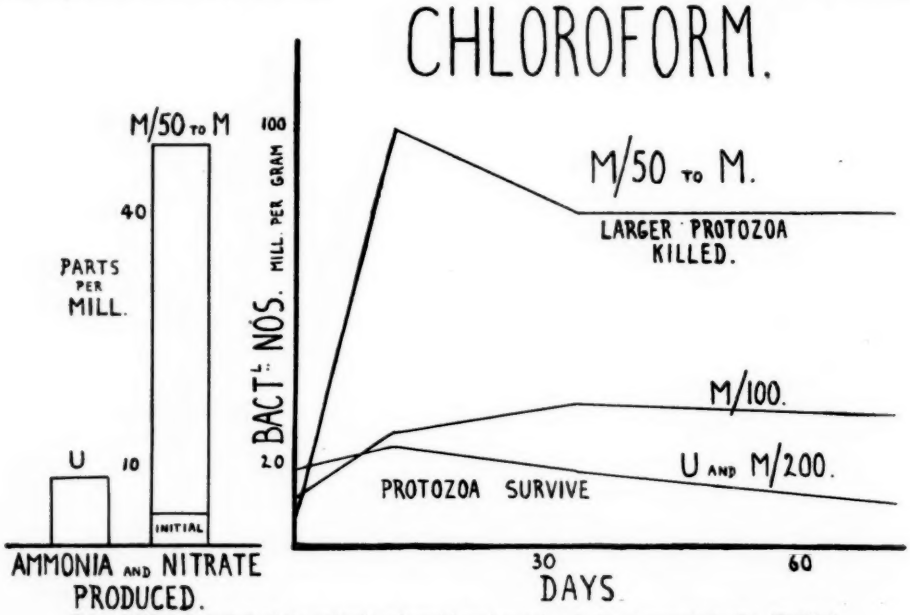


FIG. 3.—Effect of a typical volatile antiseptic on bacterial numbers and production of ammonia in soils. (Buddin.)

It was found from the soil investigations that the detrimental factor increased in intensity when the soil was kept moist, warm, and well supplied with organic matter. In these circumstances the bacteria might reasonably have been expected to increase enormously; as a matter of fact, they did not. Moreover, the fertility of these soils did not increase as much as was anticipated; it became less, and after a time no longer justified the cost of intense cultivation: this fact is well known among nurserymen, who speak of such soils as "sick." The treatment in the past has been to throw the soils out in despair, and to sacrifice the great manurial residues they contain. But it was obvious that the proper course was to adopt partial sterilisation methods; and laboratory and pot culture experiments alike proved the success of the method. For the moment, partly because no satisfactory method of enumerating active protozoa in the soil has yet been devised. The zoological work is being continued: it has already more than justified itself by revealing the presence in natural soil of a trophic protozoan fauna the members of which are of considerable interest: the most important further development will be to ascertain whether the present indications are correct that the fauna is most numerous when the detrimental factor is most fully developed, and least numerous when the factor is not much in evidence.

The "sick" soils mentioned above are so important from the technical point of view that they have been further investigated. Sickness is proved to be an excessive development of the detrimental factor and also of disease organisms. The demonstration that it could be cured by

partial sterilisation aroused much interest among nurserymen and growers who forthwith arranged to have trials made in their own glasshouses. The first efforts were, of course, crude; methods that work satisfactorily in a laboratory with a few kilos of material have a way of breaking down hopelessly when it comes to handling hundreds of tons in a commercial nursery. But the second season saw a great improvement, and the third an even greater, while perhaps the most satisfactory result of all is that the growers have collected 2500*l.*, half among themselves and half from the Development Fund, wherewith to build an experiment station to attack the special problems of their industry, and they have also obtained for it an income of some 900*l.* a year for the working expenses.

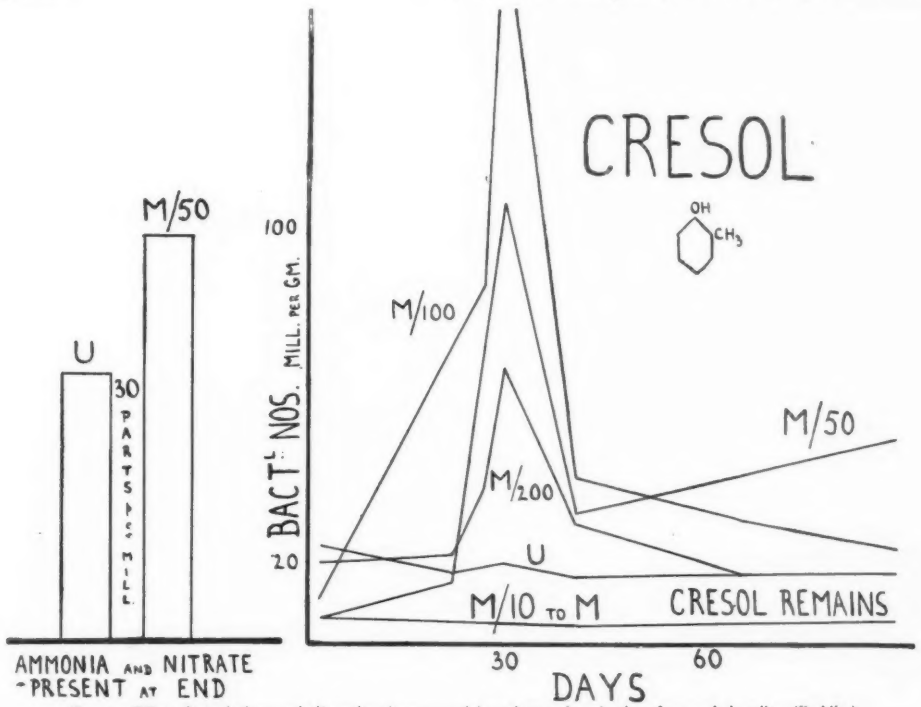


FIG. 4.—Effect of a typical non-volatile antiseptic on bacterial numbers and production of ammonia in soils. (Buddin.)

At present nurserymen use steam, but this would not be applicable for ordinary field work. The volatile antiseptics which work so well in the laboratory have also proved ineffective, even if the difficulties of application could be overcome. Search has therefore been made among solid and non-volatile liquid antiseptics. Lime was investigated by Dr. Hutchinson and found to answer satisfactorily; small doses are absorbed by the soil, but after a certain saturation point is reached the excess remains free and partially sterilises. All the usual phenomena turn up together, and the point indicated by the chemical tests is found to agree closely with that found by bacteriological and plant-growth tests (Fig. 2). Mr. Buddin has tried a wider range of substances, and finds a fundamental distinction between volatile and non-volatile organic antiseptics, illustrated in Figs. 3 and 4. Volatile compounds partially sterilise and then disappear, leaving no traces behind them: the effect on the soil depends solely on the germicidal potency of the substance. Non-volatile compounds, on the other hand, remain in the soil and react both on the organisms and the plant, but their action on the bacteria is peculiar. So long as the doses are not too strong, some of the soil bacteria flourish and multiply to an astonishing degree, apparently feeding on the antiseptic: phenol, cresol, hydroquinone, quinone, are all among the unpromising substances that produce this effect. The phenomena are quite distinct from those observed with volatile antiseptics; the rise in bacterial numbers is much higher, but it is not sustained; there is no sharp connection between the bacterial increase and the death of the protozoa, and the increased bacterial numbers do not produce any corresponding increase in ammonia or nitrate. Hence these non-volatile organic substances do not appear very promising, and for the moment steam remains the best agent: it partially sterilises; it effects some decomposition of the soil organic matter, and so lightens the subsequent work of the bacteria; and it produces some substances which induce a remarkable development of fibrous root. Experiments are still in hand, and we hope eventually to learn sufficient about these effects to be able to reproduce them in a way applicable to field conditions.

E. J. RUSSELL.

THE FAR-NORTH AUSTRALIAN.[1]

THE three volumes of studies of the natives of Central Australia which were published by Prof. Baldwin Spencer and the late Mr. F. J. Gillen, required for their completion some account of the natives of that portion of the continent which stretches northward to the shores of the Arafura Sea. This natural sequel, an account of the people of the Northern Territory, is to be found in the new and valuable record, dedicated to the memory of his dead colleague, which has just been written by Prof. Spencer. With the experience gained in his previous investigations, the author has produced an excellent volume, which is in every way equal to its forerunners in anthropological interest, in scientific value, and in clear description of another group of the totally uncivilised tribes of Australia.

FIG. 1.—Two Kakadu Men. From "Native Tribes of the Northern Territory of Australia."

The introductory chapter, aided by nearly thirty pictures, gives a particularly vivid description of the country occupied by the tribes, their appearance and dwellings, general way of living, character and mental ability. A map shows the location of the tribes, those dealt with in most detail being resident on Melville and Bathurst Islands, on the mainland about Port Essington, the Alligator Rivers and Port Darwin, and southward to the region between Victoria River on the west and Roper River on the east. The total population is estimated at about 50,000.

The social organisation most prevalent in this region was found to differ from that usual in other parts of Australia. Instead of the class organisation, in which the tribe is divided into two main divisions, each with its subdivisions regulating marriage, and with descent either in the male or female line, many of the northern tribes follow a local organisation. The people are divided into a series of local groups, each owning and occupying a special district, and on marriage a man of one group takes his wife from another, and brings her and his children into his own group. The details of the various systems are fully given by Prof. Spencer, with tables of relationship terms in a series of typical tribes, and also the status terms applied to individuals at different periods of life.

With respect to the initiation ceremonies, the author divides the northern people into three groups. The first, occupying the islands, Coburg peninsula, and adjacent mainland, practise neither circumcision nor subincision. Adjacent tribes on the south practise circumcision only, whilst others inland from the coastal ranges and towards the centre of the continent practise both circumcision and subincision.

There is much variation in the totemic systems of the tribes. Where there is class organisation the totem groups are variously divided. Exogamy, though usual, is not always strict. Where the local organisation prevails, though there may be some marriage restrictions, there is sometimes no question of descent involved, and a child's totem is revealed to the father in a dream. The totems in all the tribes are usually edible articles, animal or vegetable, but in some cases implements and natural objects are totems. In many of the tribes a man may not eat his totem, but in others,

FIG. 2.—Placing the Bull-roarer on the hands of the Initiates, Larakia Tribe. From "Native Tribes of the Northern Territory of Australia."

[1] "Native Tribes of the Northern Territory of Australia." By Prof. Baldwin Spencer. Pp. xx+516. (London: Macmillan and Co., Ltd., 1914). Price 21s. net.

though he may not capture or gather it, he may eat it if it be given to him by a man of another group. For the purpose of increasing the supply of the totemic animal or plant, certain magical ceremonies are performed. The bull-roarer and other sacred objects so prominent in the central region was not found among the tribes of the islands, the Coburg peninsula, and coast southward. The Kakadu (Alligator River) call the bull-roarer *kumali* and the Larakia (Port Darwin) *bidubidu*. The ceremonies in which they are used, and the traditions regarding them, are described by Prof. Spencer. Burial and mourning ceremonies vary greatly. The Melville islanders bury their dead in graves with elaborately ornamented grave-posts. The Kakadu of Alligator River also bury in the ground, but other tribes place the body in a tree. The Larakia follow tree-burial by burial in the earth or in holes in rocks. The Mara tribe eat their dead, and after exposing the bones on a tree platform, bury all but the long bones of the arm.

An interesting account is given of magic and medicine. Evil is wrought by burning excrement. This entices away a man's protecting spirit, and so renders him liable to accident or hunger. The same practice will give a strong man's power to a youth. Maleficent magic is also wrought with a fragment of the victim's food, or with mud scraped from his foot. Disease is cured by eating pounded ant-hill.

The author discusses the curious belief as to the origin of children which, as in Central Australia, is found also among the northern tribes. The far-off ancestors, as they travelled about, shook off spirit children into caves and trees. These enter the women at these places and are born as natives. The dead go back to their old home, and after a time are born again, the sex being changed at each new birth. Half-castes are the result of eating the white man's flour.

Two extremely interesting chapters are devoted to traditions and legends. Food restrictions are also dealt with. They show the natives specially hampered by definite rules of eating during child-bearing and youth, age being privileged.

Separate chapters describe the weapons and implements, clothing and ornaments, and decorative art, the latter including rock and bark drawings. The illustrations to these chapters, some coloured, show these northern natives to be more advanced artistically than other Australians.

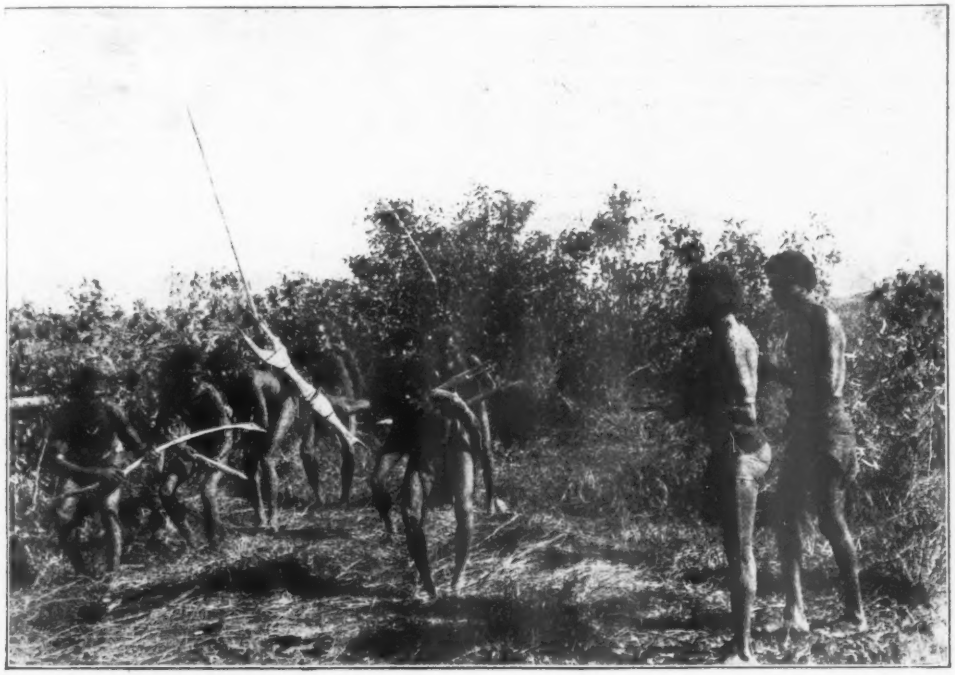


FIG. 3.—Scene from the Muraian Ceremony, Kakadu Tribe. From "Native Tribes of the Northern Territory of Australia.

There is no suggestion of Malay influence in the region, and the author gives reasons against its possibility. The valuable linguistic appendix, mainly relating to three tribes, shows the languages to be characteristically Australian.

A few inconsistencies and omissions may be noted. The Umbia and Bingongina of p. 483 appear as Umbaia (p. 7, 17), Binbinga (p. 7). The organisation of the Maluuru tribe is given (p. 56), but there is no indication of its locale or that of the Allana tribe (p. 483). The use of Austral-English appears in the use of such words as: goanna, sugar-bag, lubra, pitchi, wurley, miamia, billy, billabong, tuck-out, and tucker.

Special features of the volume are the number and quality of the illustrations. There is a good index.

The work is an exceedingly valuable contribution to anthropological literature, indispensable for the student of primitive beliefs and ceremonial. SIDNEY H. RAY.

THE EVOLUTION OF THE PETROGRAPHICAL MICROSCOPE.

WHEN Henry Clifton Sorby laid the foundation of the science of microscopical petrology, in the year 1851, the instrumental means at his command were of the simplest kind; his microscope had attached to it two Nicol-prisms, one above the eye-piece and the other below the stage, the latter being capable of rotation, thus rendering it possible to study the sections of minerals in rocks by plane polarised light. Then, as is so often the case, necessity became "the mother of invention," and Sorby himself, as well as several of his followers, devised additions to their microscopes which converted them into more useful instruments for investigating the optical properties of minerals, as seen in thin sections of rocks. The designers of these improvements were, of course, dependent on the able makers of optical instruments for putting their suggestions into practical form.

In the year 1876 the late Prof. Rosenbusch, of Heidelberg, who had been led to the microscopical study of rocks by Heinrich Fischer, one of the earliest pioneers in this branch of research in Germany, described "a new microscope for mineralogical and petrological researches." The chief features in this microscope were an accurately graduated, revolving stage, with verniers, and a complex nose-piece enabling the objectives to be rapidly changed. About the same time MM. Fouqué and Michel Lévy—with the co-operation of M. Emile Bertrand—had also turned their attention to the improvement of this class of instruments. The eminent optical instrument-maker of Paris, M. A. Nachet, carrying out their designs, constructed a microscope which embodied many advantageous features for petrographical work. In this instrument the necessity for the troublesome centring arrangements, for keeping an object on the cross-wires of the field of view, is got rid of by dividing the tube into two portions moving independently, the upper section carrying the eye-piece, analyser, and some accessory apparatus, and the lower attached to the finely graduated revolving stage bearing the objectives; these latter are easily changed by moving in a slide with spring-catch. Another important addition to the instrument which we owe to the French petrologists is the series of converging lenses with a magnifying lens above, by which interference figures may be viewed in the thin sections of minerals in rock-slides. It is true that these interference figures are only partial ones, but by the aid of diagrams supplied by the authors of the method their interpretation is rendered possible.

Outside France, the Nachet instrument would not appear to have come into very general use, a fact which is perhaps accounted for by the rather cumbrous arrangements necessitated by the division of the tube. In this country an arrangement having the same object has been devised by Mr. A. B. Dick, and has found much favour with many petrologists. It consists in having the rotating, polarising and analysing prisms so connected that they can revolve together, while the stage is fixed. The forms of the ordinary and Dick types of petrographical microscope, as employed by the officers of the Geological Survey of Great Britain are illustrated in Figs. 1 and 2.

Still more recently the celebrated Russian crystallographer, Féderow, has devised a form of the mineralogical and petrographical microscope, in which the crystal or section to be examined is carried on a stage which is capable of movement and inclination at exactly measurable angles, by which means very important optical determinations may be made. Instruments constructed on Féderow's plan are made by the Société Genevoise pour la Construction d'Instruments de Physique et de Mécanique, 87 Victoria Street, London, S.W.

As a matter of course, all the improvements in the mechanical and optical arrangements in microscopes introduced during the last fifty years have been made available for the instruments constructed for mineralogical and petrographical work. With the addition of many pieces of accessory apparatus, such as sections and wedges cut in definite directions from the crystals of various minerals, stage goniometers, and special arrangements for stage-movement, the instruments of this class have now become, as will be seen from the figures, more and more complicated as the refinement of methods has increased.

Not less important than these elaborate instruments employed in research are the simpler forms used in elementary and advanced geological teaching, which must necessarily be produced at much smaller cost. There are also special petrographical microscopes made, which are adapted for projection purposes in lecture-theatres, for photographic work, for examining crystals and sections while being heated and cooled, and for studying the development of crystals in solutions and fused materials. Examples of many of the types of petrographical microscopes are exhibited in the Science Museum at South Kensington.

As a direct offspring of the petrographical microscope, we may refer to the instruments now so extensively employed in metallographical researches. In 1864 Sorby, while studying sections of meteorites, for the purpose of comparing them with terrestrial rocks, was led to examine the grains of nickel-iron in the "sporado-siderites," after they had been etched, by reflected light. It occurred to Sorby that the same method of study might with advantage be employed in the case

of artificial irons and steels, and his residence at Sheffield enabled him to obtain the necessary materals for a research, which not only resulted in important discoveries by himself, but laid the foundation of the science of microscopic metallography, which has made such important advances in recent years.

Our illustrations are taken from the catalogue of Messrs. James Swift and Son, who in this country have been among the foremost in meeting the often difficult requirements of scientific men, by carrying out their suggestions with great practical knowledge and skill. J. W. J.

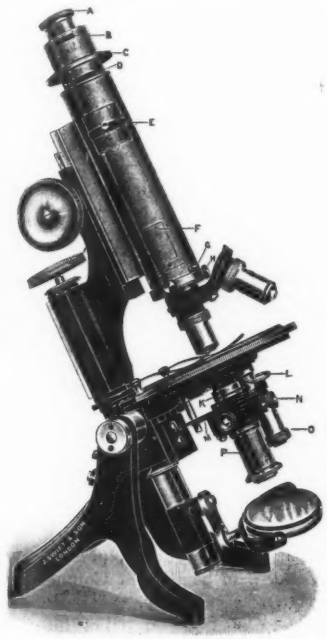


FIG. 1.—Swift's "Survey" Petrological Microscope. A, Rotating analyser working over ocular; B, slot for quartz wedge or other compensator; C, divided circle working in conjunction with analyser A; D, slot through ocular for micrometer, etc.; E, slide carrying upper Bertrand lens which can be focussed and pushed out of the optic axis when not required; F, analyser in body, instantly removable from optic axis; G, slot for quartz wedge, etc., when working with analyser F; H, centring nosepiece; J, achromatic convergent system; K, iris diaphragm; L, loop for instantly removing top hemispherical lens of condenser; M, swing-out rotating cell for stops, compensators, etc.; N, centring screws to convergent system; O, focussing adjustment for convergent system; P, polariser mounted on independent swing-out arm.

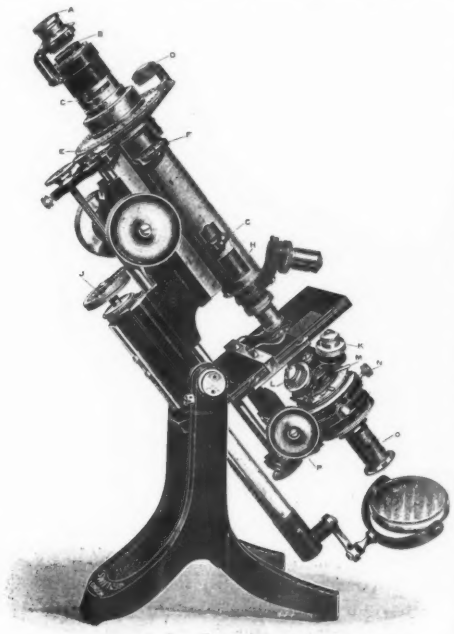


FIG. 2.—Swift's "Improved Dick" Petrological Microscope (Khartum model). A, Analyser mounted above ocular and geared to rotate simultaneously with the polariser; B, cross-webbed ocular; C, slot through ocular for wedges, micrometer, etc.; D, lens for reading circle and vernier; E, divided circle reading by vernier to 5′; F, slide bearing Bertrand lens (this lens is provided with a diaphragm of apertures and can be focussed and pushed out of the optic axis when not required); G, slide bearing lower Bertrand lens, Klein's quartz plate and a clear aperture (this lower Bertrand lens shows a much larger interference figure than the upper one, filling as it does the entire field of the ocular); H, extra analyser mounted in body (this analyser is generally used for photomicrography); J, fine adjustment by differential screw which by means of a vernier reads to 0·0002 mm.; K, aplanatic oil immersion condenser, n.a. 1·40; L, aplanatic dry condenser, n.a. 1·0; M, iris diaphragm below which is a rotating swing-out cell for stops, compensators, etc.; N, screws to centre condensers; O, polariser mounted on an independent swing-out arm; P, milled head for focussing condensers.

DR. M. C. COOKE.

BOTANISTS will learn with regret of the death of the veteran mycologist, Dr. M. C. Cooke, at Southsea on November 12. Mordecai Cubitt Cooke was born at Horning, Norfolk, on July 12, 1825. His early education was scanty, but he received help from his uncle, who instructed him in botany as well as in mathematics and languages. Some years later he became a lawyer's clerk, and afterwards a teacher under the old National School system, the economic value of food-plants being one of his teaching subjects. This led to his preparation of a catalogue for the Indian Department of the Exhibition of 1862, and eventually to work at the India Museum. Here he spent much time studying the lower cryptogams, especially fungi, on which he soon became a leading authority.

In 1880 Cooke obtained an appointment in the Herbarium of the Royal Botanic Gardens, Kew, being placed in charge of the Thallophyta, a post which he continued to hold until he retired at the age of sixty-five. Whilst at Kew he completely re-arranged the mycological collections, and incorporated the large and valuable herbarium of the Rev. M. J. Berkeley, and later on his own extensive collections, which have been estimated to number 46,000 specimens. He also dealt with material coming in from abroad, from which he described and figured many new species. During this period he was assisted in his private work by Mr. George Massee, who afterwards succeeded him in his duties in the Cryptogamic Department.

Cooke stands out as a great systematic mycologist, and as a populariser of his science. His first important work—"Handbook of British Fungi"—(1871) is a classic, which to this day demands a good price. The most celebrated is "Illustrations of British Fungi." These eight volumes, containing 1200 plates of British Agaricaceæ, are a stand-by of all British mycologists, and the fact that they are still the subject of scrutiny and criticism by eminent continental botanists only testifies to their importance in mycological literature. For twenty years Cooke edited *Grevillea*, a journal devoted to

Cryptogamic botany. He also published a fungus flora of Australia and many papers of scientific importance, besides innumerable minor articles. His industry is further attested by the presence in the Kew collections of about 25,000 of his drawings of fungi. During later years, especially, he wrote popular books, and also turned his attention to other fields of cryptogamic botany.

After his retirement in 1892 Cooke retained his interest in fungi, and until 1904 attended the annual fungus foray of the Essex Field Club. Recently his eyesight failed, though his mind remained keen and active. He was honorary M.A. of Yale, and LL.D., and in 1903 he had the honour of being awarded the gold medal of the Linnean Society. A. D. C.

NOTES.

THE King has been pleased to approve of the following awards this year by the president and council of the Royal Society:—A Royal medal to Prof. E. W. Brown, F.R.S., for his investigations in astronomy, chiefly in lunar theory; a Royal medal to Prof. W. J. Sollas, F.R.S., for his researches in palæontology, especially in the development of new methods. The following awards have also been made by the president and council:—The Copley medal to Sir Joseph Thomson, O.M., F.R.S., for his discoveries in physical science; the Rumford medal to the Rt. Hon. the Lord Rayleigh, O.M., F.R.S., for his numerous researches in optics; the Davy medal to Prof. W. J. Pope, F.R.S., for his researches on stereochemistry and on the relations between crystalline form and chemical constitution; the Darwin medal to Prof. E. B. Poulton, F.R.S., for his researches in heredity; the Hughes medal to Prof. J. S. Townsend, F.R.S., for his researches on electric behaviour of gases.

NATIONAL regret at the death of Lord Roberts on Saturday last, as the result of a chill caught while on a visit to France to see the Indian troops, is shared by men of science. Throughout his career Lord Roberts stood for scientific organisation and individual efficiency; and to the last day of his life he was concerned with undertaking useful services for his country. In the field his success was the fruit of careful forethought, boldness, and vigour; when an administrator he laid stress on the encouragement of intelligence and initiative among soldiers of all ranks; and after his retirement from active service he devoted the remainder of his days to advocating the encouragement of rifle shooting as a national pursuit, and the establishment of a system of obligatory physical training. He saw the needs of his country and did his best to educate public opinion in favour of a remedy for them. In Lord Roberts the attributes of duty and self-sacrifice were represented at their highest, and the whole Empire mourns that he has now passed into silence.

THE council of the Physical Society of London has decided not to hold the annual exhibition of physical apparatus this year.

THE eighty-ninth Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Prof. C. V. Boys, his title being "Science in the Home."

WE regret to learn of the death, at sixty-five years of age, of Dr. J. Borgmann, professor of physics in the University of Petrograd, and author of various works on electricity and magnetism.

WE regret to announce that Prof. August Weismann, professor of zoology in the University of Freiburg-im-Breisgau since 1867, foreign member of the Royal Society, and of world-wide distinction as a biologist, died on November 5 at eighty years of age.

AT the annual meeting of the London Mathematical Society, held on November 12, the De Morgan medal was presented to Sir Joseph Larmor in recognition of his researches in mathematics and mathematical physics.

A FAIRLY strong earthquake was felt over Jamaica on October 15 (see NATURE, vol. xciv., p. 207). A month later, on November 15, two other shocks were felt, the first at 12.50 a.m., of considerable force, and lasting seven or eight seconds; the second, a slighter shock, between 8 and 9 a.m. No serious damage was caused by either shock.

MR. W. S. ADAMS, Mount Wilson Solar Observatory, California; Prof. H. Andoyer, professor of physical astronomy in the Sorbonne, Paris; and Dr. F. Schlesinger, director of the Allegheny Observatory, and professor of astronomy, University of Pittsburgh, U.S.A., have been elected associates of the Royal Astronomical Society.

IT is announced in the *London Gazette* that the King has appointed Mr. T. H. Warren, president of Magdalen College, Oxford, to be Knight Commander of the Royal Victorian Order, and Mr. C. G. Robertson, fellow of All Souls' College, and senior tutor in modern history at Magdalen College, Oxford, to be Commander.

FOR several years Prof. W. B. Bottomley, King's College, London, has been working on the bacterial treatment of peat; and some results of the investigation have been described in papers presented to the Royal Society and the British Association. The Board of Agriculture has now made a grant of 150*l.* to the botanical department of King's College in aid of research on the subject of the probable accessory food-substances in humus and "bacterised" peat, a condition of the grant being "that reasonable facilities will be accorded to any accredited scientific worker who may desire to undertake investigations in connection with 'bacterised' peat."

AT the anniversary meeting of the Mineralogical Society, held on November 10, the following officers and members of council were elected:—*President*: Dr. A. E. H. Tutton. *Vice-Presidents*: Prof. H. L. Bowman and Dr. A. Hutchinson. *Treasurer*: Sir William P. Beale, Bart. *General Secretary*: Dr. G. T. Prior. *Foreign Secretary*: Prof. W. W. Watts. *Editor of the Journal*: Mr. L. J. Spencer. *Ordinary Members of Council*: Mr. F. H. Butler, Mr. J. P. De Castro, Mr. B. Kitto, Prof. A. Liversidge, Dr. J. J. Harris

Teall, Mr. F. N. Ashcroft, Prof. H. Hilton, Mr. A. Russell, Mr. W. Campbell Smith, Dr. J. W. Evans, Dr. F. H. Hatch, and Mr. J. A. Howe.

AT a meeting of the council of the British Association, held on November 6, it was resolved:—"That the council of the British Association for the Advancement of Science, at its first meeting in London since the return of members from Australia, desires to place on record its high appreciation of the generous reception given to the members of the overseas party throughout the Commonwealth by representatives of the Governments of the Commonwealth and the States, and by other authorities and Australian citizens generally, on the occasion of the meeting of the association in Australia in 1914. The council hereby expresses its grateful thanks for the hospitality, privileges, and concessions extended so freely to visiting members, and also for the willing and valuable collaboration of all those who undertook so successfully the work of organisation in Australia in connection with the meeting."

BY the death of Sir Walter Gilbey at Elsenham Hall, his Essex residence, on November 12, the country is distinctly the poorer, as the deceased baronet had an unsurpassed practical knowledge of horses and horse-breeding, more especially as regards "shires," hackneys, and ponies. His two little books on these breeds are models of what such works should be, teeming, as they are, with practical and historical information condensed into the briefest possible space. Sir Walter was the founder of the Shire Horse Society, which published its first stud-book in 1880, and held its first show at the Agricultural Hall in 1881. He also took an active part in the establishment of both the Hackney Horse Society and the Hunters' Improvement Society, and he was likewise instrumental in diverting the grants for "Queen's Plates" to the more useful purpose of premiums for thoroughbred sires. He was in turn president of both the Shire Horse and the Hunters' Improvement Society. It may be added that Sir Walter did no less good service for stock-breeding and agriculture in general. He had attained the ripe age of eighty-three years.

AMERICA has lost one of her leading geographers by the death, in his sixty-ninth year, of Mr. Henry Gannett. After graduating at the Harvard Scientific and Mining Schools, he was for a short time an assistant at the Harvard Observatory. From 1872 to 1879 he acted as topographer for the Hayden Survey of the Territories. When the U.S. Bureau of Geological Survey was established in 1879, Mr. Gannett assisted in planning out its work, and from 1882 until his death he held the position of its chief geographer. He was geographer to three decennial censuses and to the Conservation Commission of 1908–9, chairman of the U.S. Geographical Board, and president of the National Geographic Society. His published works included gazetteers of twelve States, the statistical atlases of three censuses, the contour map of the United States, a manual of topographic surveying, and numerous official reports. In an editorial note on his career the New York *Evening Post* pays him the tribute that, in spite of the notable results of his own industry, it is as a stimulator of other geographers and map-makers that he chiefly deserves to be remembered.

WE are glad to see again the familiar pages of the *Revue Scientifique*, the publication of which was suspended at the beginning of August, on account of the war. The number which has just reached us is the first to be published since August 1, and it bears the date August 8–November 14. The main part of the issue is made up of the papers upon the nature and treatment of wounds, presented to the Paris Academy of Sciences on August 10 and September 28, and referred to already in our columns. Following these is a translation of the statement signed by German professors as to the cause of the war, with a complete list of signatures, and replies to the manifesto made by the Academy of Sciences, the French Academy, Institute of France, representatives of Russian art, literature, and science, and British scholars. Sir William Ramsay's article on "Germany's Aims and Ambitions" is translated from NATURE of October 8, and there is also a translation of the letter from Dr. C. W. Eliot, president of Harvard University, published in the *New York Times* of October 2. We trust that our contemporary will find it possible to continue its weekly issue as formerly. *La Nature*, which suspended publication on August 1, has not yet started a re-issue.

ACCOUNTS of the valuable work which the officers of the Royal Army Medical Corps have accomplished in Boulogne for our wounded are given in the *Times* of November 10 and 14. The description of the Boulogne hospitals affords a clear picture of the very best sort of hospital administration and practice, thanks to Colonel Lynden Bell, Sir Almroth Wright, and all members of the staff and nursing staff of each hospital. From the potent and unfamiliar infections of the Belgian soil, which has been under intensive cultivation and incessant manuring for a quarter of a century, comes a host of troubles. The majority of the wounds are contaminated at the moment of infliction. The usual ritual of the antiseptic and aseptic method, perfect in time of peace for this or that formal operation of surgery in a placid, well-appointed hospital, may not suffice for the treatment of men wounded in the trenches by shrapnel or shell fragments, their clothes and their skins caked thick with mud, and that mud carrying dangers of its own. Against the risk of tetanus, we have the protective use of the tetanus antitoxin; against gangrene, we have the injections of oxygenated water, and the later "open-air" treatment of the wound, and there are other methods by which science is used to reduce suffering at the Boulogne hospital base and elsewhere.

IN *Man* for November, Prof. Carveth Read examines the question of the differentiation of man from the anthropoids. He dwells on the importance of the change from a vegetable to a carnivorous diet on the habits, functions, and structure which distinguish man from the higher apes. This change of diet, he urges, explains the adaptation of our species to a ground-life and to a world-wide diffusion. This in-

volves social co-operation, the growth of articulate speech, the invention of weapons, and the discovery of the use of fire. Again, it involves the growth of the erect gait and of other modifications in the bodily structure. He urges that if this hypothesis be not accepted, man is an exception to the rule of animal life—that the structure of every organism is made up of apparatus subserving its special conditions of nutrition and reproduction.

WITH part viii. of his useful periodical, *Visvakarma* Mr. A. K. Coomaraswamy has for the present suspended its publication. The work contains one hundred examples of Indian architecture, sculpture, painting, and handicrafts. Mr. Eric Gill supplies a rather flamboyant introduction. The nineteenth century, he tells us, "for all its hard-headedness, was soft-hearted and loose-thinking." The newly awakened interest in Oriental art is, he thinks, "a genuine reaction against the irreligious gentility and banality of modern European art." There is some excuse for this acrid criticism, and *Visvakarma* helps to show that the art of India has much to interest the European student. But the cause of Oriental art will scarcely be promoted by disparagement of the aims and methods of European artists.

MESSRS. C. A. Hall and Duncan Smith have reprinted from the Transactions of the Paisley Philosophical Institution, 1914, a paper dealing with the geological and historical significance of some hazel nuts and other plant remains discovered during excavations at Paisley Abbey in March, 1914. These remains rested on the gravel of an ancient sea-beach, which is believed to be the 25-ft. raised beach, a pronounced feature in various parts of the Clyde area. This, after attaining its maximum elevation, was depressed and submerged. When hazel trees grew in this area it was some 25 ft. lower than it is at present. The writers, associating Neolithic man with the 25-ft. raised beach period, urge that their investigation forms a fresh link in the chain of evidence by which the age of Neolithic man may be determined.

A CLASS in mineralogy, with free access to a representative series of specimens, is the latest development of the Children's Museum, Bedford Park, Brooklyn. The collection of minerals, according to the November number of the *Children's Museum News*, has also been rearranged and expanded, economic uses being the basis of classification.

"THE Middle Triassic Marine Invertebrate Faunas of North America" is the title of a very fully illustrated memoir by Prof. J. Perrin Smith, published in Washington by the Department of the Interior (U.S. Geological Survey) as Professional Paper No. 83. It deals chiefly with cephalopods, especially ceratites and other ammonoid groups, 142 out of the 148 pages of letterpress being devoted to that class. In Triassic times the sea, which had previously covered large portions of the area now occupied by the North American continent, had retreated westwards until it formed only a gulf in the region of the Great Basin. The most remarkable feature of the fauna of the Middle Triassic beds of this tract is its complete lack of relationship to that of Japan, and its marked affinity to that of south-eastern Europe. It is, in fact, of "such a distinctly Mediterranean character that if a palæontologist from Austria were set down in the Triassic area of the Humboldt desert he could hardly tell from the character of the fauna whether he was collecting in Bosnia or in Nevada."

PROF. PERRIN SMITH'S work on the Triassic ammonoids referred to in the preceding paragraph was doubtless the forerunner of a paper on accelerated development in fossil cephalopods, issued in the Leland Stanford Junior University Publications, University Series, for 1914. To do justice to this thoughtful communication would take much more space than is at our disposal; and it must suffice to state that, owing to the compression of the earlier stages, a large number of groups do not exhibit a recapitulation of their ontogenetic history. There is, in fact, a constant loss of stages or characters, which become pushed back and finally crowded out of the ontogeny, all along the race-history, so that successive types do not exhibit their full genealogical story. In addition is "convergence," which, in ammonites, has rendered a number of types descended from perfectly distinct ancestors so alike as totally to defy recognition of their genealogy.

MR. FREDERICK CHAPMAN provides a comprehensive review of the Cainozoic strata of Australia in the fifth memoir of the National Museum, Melbourne (July, 1914). He shows that the supposed nummulites of Australia should be referred to Amphistegina, and regards the earliest beds of what he calls "the Australian Cainozoic system" as of Oligocene age. The correlation of the strata with those of Europe, and the description of typical sections, make this paper especially welcome.

THE inspiring story of the rise and progress of the Scottish school of geology was selected by Prof. T. J. Jehu as the subject of his inaugural lecture as Murchison professor of geology and mineralogy in the University of Edinburgh. Due stress was laid in this discourse on the influence of Sir Andrew Ramsay, T. F. Jameson, Sir Arch. Geikie, also Prof. J. Geikie and other Scottish workers, in promoting a just appreciation of glacial phenomena in our islands.

PROF. GÜRICH, of Hamburg, has published (Borntraeger, Berlin, price 5.50 marks) an illustrated account of "Die geologischen Naturdenkmäler des Riesengebirges," which forms a scientific guide to a region of granite tors and ice-worn hollows which has been little visited by strangers. The fine view of the Schistose Schneekoppe (1605 miles) reminds us of our own highlands, where the cirques are becoming modified by downwash and general decay. A block of orbicular granite is figured, which is probably of local origin. This, like other natural monuments in the district, has been put under special guardianship.

ONE of the most interesting and readable memoirs issued in the Clare Island Survey series is by T. Hallissy on the geology of the island (Proc. Royal

Irish Academy, vol. xxxi., part 7, price 1s. 6d.). Reference is made for further details to the memoir recently published by the Geological Survey of Ireland; but the present account shows especially how the district was influenced by the ice of glacial times, and an excellent series of illustrations has been included, most of which were hitherto unpublished. The map of Clew Bay and its numerous partially-drowned drumlins will interest those who have entered Boston harbour from the sea. The large coloured geological map is repeated, by arrangement with the Controller of the Stationery Office, from the Geological Survey memoir.

WE have frequently taken occasion to refute some of the long-lived popular fallacies relating to the weather. The *Scientific American* of October 24 refers to a statement in a recent London weekly journal that "it is one of the extraordinary things of warfare that a big battle invariably produces rain." Our American contemporary has no difficulty in refuting the "particularly fatuous fallacy" that a battle could have any appreciable effect on the temperature or humidity of the air, upon which conditions rainfall depends. He points out that rainfall may follow battles for various reasons, *e.g.* meteorological records in northern France show an average of about 157 rain-days per annum, according to which rain might possibly fall about every other day. Recent literature upon the subject is abundant and conclusive; as one instance we may refer to an interesting and instructive article by Prof. Cleveland Abbe in the United States *Popular Science Monthly* of January, 1911, which shows by laboratory experiments that the firing of cannon or dynamite to produce rain cannot possibly succeed. We may also mention a pertinent communication to *Symons's Meteorological Magazine* of March, 1911, in which Mr. F. Gaster (formerly of the Meteorological Office) pointed out that at Shoeburyness, where great guns are fired almost daily, the average rainfall is probably the smallest in the United Kingdom.

THE Committee of the Institution of Civil Engineers, which has been making inquiries as to the best course of training for engineers, mentions in its report that one firm considered technically trained men of "no use for dividend earning." Mr. F. M. Denton, in a letter in the *Electrician* of November 6, points out that this prejudice against technical college-trained men on the part of engineering firms has cost us very dearly in the past, much of our best trade, and more new trade we should have liked, having gone to our rivals. The hope of regaining and retaining this trade in the future is, he considers, elusive unless manufacturers are prepared to recognise that a technical training permits a man to see further than he would otherwise do, and that research carried out by such men has been responsible for practically all the advance in heavy electrical engineering in recent years. We cannot as a nation content ourselves with merely making and selling what others have developed, but must provide our own army of research, and lead instead of following.

IN the *Comptes rendus* for November 3 M. G. Lippmann directs attention to the possibility of applying the Hughes induction balance to military surgery. This invention, it is remarked, appears to-day to be totally forgotten. It consists of a battery, two small induction coils, a contact-breaker, and a telephone, the connections being crossed in the primary circuit so that the induced electromotive forces are in contrary directions. The coils can then be adjusted so that no sound is heard in the telephone in the secondary circuit. On the approach of a metallic mass to one of the bobbins, a sound is heard in the telephone. If the metal is magnetic, as is the case with a fragment of shell or a German bullet, the effect is more marked; French and German bullets can in this way be distinguished. M. Lippmann thinks the apparatus should be useful in military surgery, as it is easily made in numbers, simple to use, portable, and cheap.

ALUMINIUM is now employed to a greater or less extent in almost all engineering and allied trades, but it is doubtful if the full extent and variety of its applications are generally recognised. About 60,000 tons of the material are produced every year. *Engineering* for November 13 points out that there is no reason why the foundry of a general engineering shop should not produce aluminium castings in the same way that it now produces those of the copper alloys. Probably the reason for the neglected use of aluminium is that the average engineer is not practised in the manipulation of this metal. A quite definite case can be made out for the employment of aluminium for low-tension electric cables, particularly those of large section. There are a number of important installations in existence, *e.g.* the Paris General Omnibus Company has 650 tons of aluminium cables, yet on the whole the material does not occupy the position which might be expected. There is little doubt that in many cases copper cables are now being installed where important saving might be made by employing aluminium.

OUR ASTRONOMICAL COLUMN.

COMET 1914*d* (LUNT).—The comet discovered by Dr. Lunt at the Cape Observatory is travelling northward, and the elements and ephemeris (the *Observatory*, November) have been calculated by Drs. Hough and Halm, and these are as follows:—

Elements.

$T = .914$ August 4·91638 G.M.T.
$\omega = 269^\circ\ 53'6''$
$\Omega = 0^\circ\ 22'5''$ } 1914·0
$i = 77^\circ\ 53'3''$
$\log q = 9{\cdot}85024$

Ephemeris for Greenwich Midnight.

	R.A. h. m. s.	Decl. ° ′
Nov. 18 ...	21 51 8 ...	+8 27
22 ...	53 20 ...	9 13
26 ...	55 41 ...	9 56
30 ...	21 58 21 ...	10 38

It is stated that the corrections to the above on October 11 were −20s, +7′, and on October 17 −25s., +11′.

SERIES LINES IN SPARK SPECTRA.—In the issue of this journal for April 9 of the present year (vol. xciii., p. 145) a summary was given of the Bakerian lecture delivered by Prof. Fowler on April 2 on series lines in spark spectra. Attention is directed to the fact that this lecture is now published in the *Philisophical Transactions* of the Royal Society (Series A, vol. ccxiv., pp. 225–66), and is accompanied by some excellent reproductions from photographs of the spectrum of the magnesium arc *in vacuo*, the various series of arc and enhanced lines being clearly indicated.

A BRILLIANT FIREBALL.—Mr. W. F. Denning writes: "On November 11, at 11.13 p.m., a magnificent meteor was seen from near Purley, Surrey, Stowmarket, Hornsey, and other places. It looked like an unusually large ball from a Roman candle firework, and moved very slowly in the north-east sky, occupying about 6 sec. in an extended course. It was not a Leonid, but apparently from a radiant near α Lyræ in the north-west. The meteor illumined the sky vividly for several seconds, and was evidently rather near the earth's surface. From a preliminary discussion of the few descriptions already to hand it appears that the object fell from a height of fifty to thirty-two miles, and its velocity was about eleven miles a second. There is no known shower near Vega at the middle of November, but certain large meteors appear to be isolated. Some of the observers supposed it to have been one of the regular November meteors, but its direction was different and its speed altogether too slow for it to have been a Leonid."

MEASURED PARALLAXES SUMMARISED.—A reprint from the *Astronomische Nachrichten*, No. 4754, has been received, and it contains a communication on measured parallaxes summarised by Mr. O. R. Walkey. The author states that in view of the inherent uncertainty of all measured parallaxes, it does not seem profitable to enter into a detailed discussion of the individual results, but instead the results are summarised in a series of tables of distance and consequent luminosities and cross-motions speeds according to the spectral type. The tables given represent 521 stellar systems, not counting the sun. The first three tables do not include the Hyades group, which consists mainly of first-type stars; these are dealt with in a fourth table according to their component spectral classes. The investigation is one that is the result of a large amount of labour, and the essence of the work lies in the tables, which will no doubt be carefully scrutinised by those to whom the subject is of special interest.

REPORT OF THE PARIS OBSERVATORY FOR 1913.—Like all other large observatories situated in or near towns, the work of the Paris Observatory is being severely handicapped by the presence of disadvantageous observing conditions such as smoke, night glare, etc. The report for the year 1913 gives a good idea of the great number of branches of work undertaken, but in the different summaries of the recent progress there is an underlying tone of regret that much cannot be done and much that is done is not as satisfactory as it might have been owing to the present observing conditions. Monsieur Baillaud, the director, opens his report with a reference to the deplorable conditions of the actual situation and to the indispensability of the creation of a branch establishment which he advocated two years ago. With regard to the meridian work, the north and south horizons have been shut out by seven-storey buildings, and he points out how the work of the equatorials is restricted by the haze and fog in the lower strata of the atmosphere of Paris. Comet Delavan was estimated as of the eleventh magnitude at Besançon, Bordeaux, and Lyon, while at Paris it appeared of magnitude 13. Regular photometric work, so important for the undertaking of the Carte du Ciel, is described as impossible, and in the astrophysical department the quality of the stellar images projected on the slit exercises unfortunately a very great influence on the determinations of radial velocity. Numerous other references to other branches of work effected are given, making a clear case for the necessity for an out-station. For the present, no steps can be taken, but it is hoped that in the near future Monsieur Baillaud's appeal will be considered and carried out. The annual report takes the same form as in previous years, and the work of the several departments during the past year is described in the various sections.

THE FUNCTION OF THE EARTH IN RADIO-TELEGRAPHY.

A LECTURE on the above subject was delivered on Friday evening, November 13, by Dr. J. A. Fleming, to the members of the Wireless Society of London, at the Institution of Electrical Engineers. Dr. Fleming said that the present period of enforced inactivity for all loyal radio-telegraphists, except those engaged at the seat of war, offered an opportunity to re-consider some of the purely scientific questions involved in the art. He proposed therefore to discuss the function of the earth in radio-telegraphy. Apart from the disputed question whether the aerial wires should preferably be earthed at the base or connected to an insulated balancing capacity, it was well known that the nature of the soil or surface between the transmitting and receiving stations had a great effect on the signal strength. This effect depended much upon the wave-length. Thus Dr. L. W. Austin had shown that the ground to the north and north-east of Newport, Rhode Island, U.S.A., exercised a powerful absorption on radio-telegraphic waves of about 1000 metres wave-length. Experiments made between Brant Rock wireless station and a U.S. cruiser *Birmingham*, lying at Newport, showed that whereas electric waves of 3750 metres wave-length suffered little or no absorption in travelling over the 45 miles other than that due to the normal space decrease of energy, waves 1000 metres in length lost 95 per cent. of their signalling energy in passing over the same district.

Dr. Fleming first gave a brief mathematical discussion showing the manner in which the gradual penetration of an alternating current into a conductor can be explained. It is well known that high frequency electric currents are confined to a thin skin or layer of the surface of metallic wires. In the case of copper this skin has a thickness of about 0·25 mm. for currents of a frequency of one million. In the case of iron the skin for the same frequency is about 0·02 mm.

An elegant experiment was shown by Dr. Fleming with his cymometer to illustrate this surface flow of high-frequency currents. An oscillation circuit was arranged in which high-frequency currents were generated, and these were detected by placing alongside a cymometer having a Neon vacuum tube as a detector of secondary oscillations in its circuit. In the primary oscillation circuit were inserted successively small spirals of copper, brass, iron, and galvanised iron; all having the same size and same number of turns. The oscillations in the cymometer circuit were indicated by the brilliant glow of the Neon tube. When the iron spiral was inserted the Neon tube did not glow, because of the damping of the oscillations caused by the energy absorbed to magnetise the iron.

The galvanised iron spiral behaved, however, just like a copper or brass spiral, because the oscillations did not penetrate through the thin layer or skin of zinc into the iron. If, however, this zinc was oxidised or broken, then the iron core exerted its effect in damping the oscillations.

Dr. Fleming then explained that when a radio-telegraphic wave passes over the earth it penetrates to some extent into it, and also loses amplitude owing to the absorption of wave energy by the soil. The depth of penetration or depth in which the forces attenuate to $\bar{e}^1$ or to 0·368 of their surface value, and the horizontal attenuation or distance in which the surface values decrease to the same fraction of their original value can be calculated as shown by Dr. Zenneck when the values of the soil conductivity, soil dielectric constant, and frequency are known. Thus taking the generally accepted values for sea water for waves 1000 ft. in wave-length, the penetration into the sea is at most about one metre. In the ordinary dry soil it may be 100 or several hundred metres. There is a certain soil conductivity and wave-length which gives the maximum attenuation of the wave over a given distance.

The calculation of the depth of penetration and attenuation of the wave with distance can be made when this soil conductivity and dielectric constant is known. Recent researches have shown, however, that the conductivity of imperfect insulators for alternating currents is much greater than for direct currents. Dr. Fleming referred to researches by himself and Mr. Dyke for proof of this fact. Lately, he said, Mr. Bairsto had continued this work in his laboratory for currents of extra high frequency of one or more million, and found their dielectrics had a maximum conductivity for a certain high frequency. The inference from this was that the earth was an incomparably better conductor for the high frequency currents used in radio-telegraphy than for ordinary low frequency or steady currents. Dr. Fleming then went on to consider the propagation of an electric wave over the earth's surface, and pointed out that Sommerfeld had shown that when a Hertzian oscillator had one half connected to the earth there would not only be space waves through the dielectrics (air and earth), but a surface wave along the surface which would consist in longitudinal electric currents propagated as a wave motion along the surface. Dr. Fleming pointed out that this surface wave might be the explanation of the well-known facts that signals from long distance wireless telegraph stations can be picked up and detected without any high receiving wire, merely by connecting one end of the receiver to the earth and the other to any insulated mass of metal in the interior, it may be, of a house.

Passing then to the consideration of the diffraction of long electric waves round the earth, Dr. Fleming gave a brief account of the state of the theories advanced by Poincaré, Nicholson, Macdonald, and Rybczynski. These agreed that the amplitude of an electric wave sent out horizontally from any point on the earth's surface diminished according to an exponential function of the distance and wave-length. The last-named analyst had shown that this function was of the form $\bar{e}^{0\cdot0018r/\sqrt[3]{\lambda}}$ where r is the distance of the sending and receiving stations, and λ is the wave length. Actual observations by Austin over distances up to 1000 miles had led to an empirical formula differing only in that $\sqrt{\lambda}$ appears instead of $\sqrt[3]{\lambda}$.

The bulk of the evidence so far collected as to long distance transmission showed, however, that true diffraction of space waves or even the surface waves could not contribute more than a moderate fraction, perhaps not 20 per cent., to the total observed result. The chief part of the effect for distances of 3000 to 4000 miles must be contributed by space waves which had reached the receiving station indirectly, that is, after reflection or refraction at the surfaces of layers of high-altitude ionised atmospheric gases in the manner explained by Heaviside and by Eccles.

The great variations in signal strength taking place from day to day in long-distance wireless intercourse proved that this must be the case.

In conclusion, Dr. Fleming exhibited a chart showing the variation in the strength of the signals received at University College, London, from the Eiffel Tower station in Paris at 11 a.m. each day during last July, prior to the outbreak of war. The sudden falling off on certain days was remarkable. Dr. Fleming said that the further examination of the cause of these variations was one of the chief objects of the British Association Radio-telegraphic Committee which was appointed at Dundee in consequence of a suggestion made by him, and that as soon as the present calamitous world-war came to an end it was hoped these researches might be resumed.

THE CANADIAN ARCTIC EXPEDITION.

THE Scottish Oceanographical Laboratory, which had much to do with the oceanographical equipment of the *Karluk*, and especially the outfit of the Scottish contingent, consisting of Mr. James Murray, Dr. Alastair Forbes Mackay, and Mr. W. L. McKinlay, is in receipt of a considerable amount of official and private information concerning the Canadian Arctic Expedition. The expedition was hurried in its preparation and late in its departure, and the plans were "still pretty fluid" on July 21, 1913. On August 5 the *Karluk* was beset in 145° W., and drifted west to Colville River by September 7, and remained there until September 20, when she was blown adrift by a gale. Stefánsson and a party were ashore hunting on September 19, and were thus stranded. The *Karluk* drove north and west past Cape Barrow until she reached 73° N., 162° E.; then she drove south-west and west until, on January 10 last, she was crushed and sank in 38 fathoms sixty miles north by east of Herald Island. She drifted eight hundred miles at a rate of seven miles an hour. A perilous escape was made to Wrangell Island, at the heavy cost of eight lives, to which were afterwards added three more deaths on Wrangell Island, *i.e.* eleven in all.

This death-roll includes all the scientific staff except Mr. W. L. McKinlay, of Glasgow, a former assistant to Dr. W. S. Bruce. The other scientific workers missing or dead are Mr. James Murray, of Glasgow, late biologist of the Scottish Loch Survey, naturalist to the first Shackleton expedition, and worker upon the *Scotia* invertebrates; Dr. A. Forbes Mackay, of Edinburgh, who had had wide experience in many spheres of active life, including the Royal Navy, the South African War, and was member of the party that first ascended Mount Erebus, as well as that which reached the south magnetic pole under the leadership of Prof. David; Mr. Beauchat, anthropologist; Mr. Bjorn Mamen, topographer; and Mr. G. Malloch, geologist. Besides these, Mate Anderson, Second Mate Barker, and four seamen have also perished. Captain Bartlett, of North Pole fame, with an Eskimo, made an escape with difficulty from Wrangell Island to the mainland of Siberia, and there, with the help of the Russian Governor, Baron

Kleist, got Captain Petersen, of the whaler *Herman*, to take him to St. Michael. A gasoline schooner, *King and Wing*, of Seattle, relieved the Wrangell Island party, which was afterwards transhipped to the *Bear*. Stefánsson and two men started north from Martin Point on March 22, 1914, and on April 16 were to have returned after fifteen days. Stefánsson and his men have not been heard of since. He believed currents might drive them towards Banks Land, but on this coast, though searched, no trace of them has been found. The drift of the *Karluk* makes it unlikely that he has reached Banks Land.

BRITISH SUPPLY OF SYNTHETIC COLOURS.

THE Board of Trade has had under consideration the question of the supply of dye stuffs and colours, the shortage of which at the present time, owing to the cessation of imports from Germany, is causing apprehension in the textile trades and in other important British industries.

After consultation with the Committee on Chemical Manufactures, appointed in August last under the chairmanship of the Lord Chancellor, it appeared to the Board advisable to take such steps as were possible to develop the immediately available sources of supply, and also to encourage the permanent manufacture of dye stuffs and colours in the United Kingdom on a large scale, so as to guard against any recurrence of the present difficulty. As regards interim steps, arrangements have been made to encourage the immediate expansion of the various existing sources of supply.

As to the permanent supply, after preliminary consultations with representatives of some of the principal bodies of consumers, a meeting was held at the offices of the Board of Trade on November 10, and was attended by the representatives of twenty-two important associations and firms engaged in the colour-using industries. There was laid before the meeting a scheme for the formation of a limited company with a large capital, of which the bulk would be subscribed by the consumers of dyestuffs and colours and others interested, the Government indicating their willingness, conditionally on this being done, to subscribe a certain proportion of the share capital and to guarantee the interest on a large debenture issue for a term of years. Precautions would be taken to preserve the British control of the enterprise and to prevent undue encroachment on other branches of the chemical trades.

The meeting was informed that preliminary arrangements had been made enabling his Majesty's Government to acquire important dye-producing works in this country for the purposes of the new company if established, and that the Government would be prepared to take all necessary steps to secure the acquisition of any other concerns in the United Kingdom, the transfer of which to the new company might be desirable.

The meeting unanimously adopted a resolution approving in principle of a national effort being made by the trade to increase the British supply of synthetic colours and welcoming the assistance of his Majesty's Government for that purpose. A small committee representing the trades concerned was appointed to confer with the Board of Trade with a view to the elaboration of a scheme on the lines discussed at the meeting. The first meeting of this committee was held later in the afternoon. A further announcement as to the proposed company will be made at an early date.

METALLURGY AT THE ROYAL MINT.

ONE of the most interesting features of the forty-fourth annual report of the Deputy-Master and Comptroller of the Mint just received is the comparison of the melting costs according as coke or coal-gas is used as the fuel. The former was used up to the year 1909, but has since been replaced by the latter. Although the gross out-turn was 1197·7 tons in 1909, as against 1957·9 tons in 1913, the records are comparable, since the proportion of bronze and nickel-bronze—which require higher temperatures for melting than gold and silver—was nearly the same, viz., 56·3 per cent. in the earlier and 55 per cent. in the later year. The comparison is remarkably in favour of coal-gas firing, since there is a gross saving of 22·44 shillings per ton of bars, or 27·3 per cent. of the total charge in 1909. Moreover there is a saving under each item of expense, viz., fuel, crucibles, and wages. It is stated that "side by side with this economy there has been a marked increase in efficiency both in regard to the output per furnace and per man, as well as many minor economies, such as the disposal of ashes, handling of fuel, and a great reduction in the weight of sweep to be dealt with."

Sir Thomas Rose's experiments on the effect of impurities on the temperature at which gold is softened by annealing have been confirmed and extended by Mr. Phelps. The presence of two parts of hydrogen per 100,000 raises this temperature from 130° C. to at least 300° C. Silver has a similar, though less, effect. It has now been found that the relative purity of two samples of "proof" gold "can be more readily determined by heating hard-rolled test-pieces at 130–150° for half an hour than by ordinary methods of assay." The degree of softening is either measured in some form of hardness tester or is judged by the extent of recrystallisation of the metal. Sir Thomas Rose's experiments on the mode of recrystallisation of gold in various stages of annealing are of great importance, and bear directly on cases of failure of metal tubes and rods which are subjected to partial annealing conditions spread over lengthened periods of time.

The three countries—Austria, France, and Turkey—use pure nickel as a coinage metal. In the first-named this metal has been coined and issued regularly since 1892. In France it was adopted for 25 centimes only in 1903, but a new law passed on August 4, 1913, provides for the withdrawal of this issue and of the present bronze currency, and their gradual replacement by 25, 10, and 5 centime pieces, all of pure metal. The new issue will be spread over a period of ten years, and will amount to 780 million pieces. The French Government has signed a contract with a French nickel company for twenty years to purchase the requisite metal at 141*l.* a ton, the present price in the London market being about 171*l.* a ton.

Thirty-four countries use a 75 per cent. copper and 25 per cent. nickel coinage alloy, while Germany and Switzerland coin both pure nickel and the above-mentioned alloy. H. C. H. C.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THE physiological section of the British Association began its programme for the Australian meeting in Melbourne. Considerable alterations had to be made at the last moment owing to the unavoidable absence of members who were expected to contribute to a general discussion upon climate from a physiological point of view. This is a subject to

which considerable attention has been paid in Australia, and very complete meteorological statistics from all parts of the country are available. Wet- and dry-bulb records of temperature, rainfall, and other particulars were furnished by the authorities, and the climatic conditions of Northern Australia in particular have already been analysed locally with a view to determine the possibility of the settling of these regions by a white population. Australians are determined to people their country with none but a white population, and one of the problems of the country is how to bring this about successfully under the diverse conditions which prevail in the large tropical areas of the north.

The time at the disposal of the section was reduced by alterations in the train arrangements between Melbourne and Sydney, and Sydney and Brisbane, and by the numerous interesting excursions and hospitalities so lavishly provided by the local committees. The conditions created by the war, too, naturally deprived the meetings of the interest which they would otherwise have occasioned. In spite of this the meetings were very successful, especially in Melbourne, and it was only towards the close in Sydney that interest in the business of the section slackened.

A very full programme was presented and carried out in Melbourne. Prof. B. Moore opened the proceedings of the section by an address upon the value of research in the development of national health, and put in a strong plea for the wider application of modern scientific discoveries to the promotion of the health of the race. Sir Edward Schäfer exhibited a number of lantern slides of sections of the mammary gland, and pointed out the presence around the alveoli of non-striped muscle fibres. It is to the contraction of these fibres that he ascribes the lactagogue effect of injections of pituitrin. Prof. Halliburton, in collaboration with Dr. W. E. Dixon, gave an account of their recent investigations into the physiology of the cerebro-spinal fluid. Numerous lantern slides were shown illustrative of the response to intravenous injections of various extracts by the production and pressure of the cerebro-spinal fluid. They find extracts of dried choroid plexus to be especially active in increasing its production. Certain anæsthetics, and excess of CO_2 in the blood particularly, are also powerful stimulating agents. Evidence was adduced to prove that cerebro-spinal fluid is a true secretion, and that it is largely formed by the cells of the choroid plexus. The hormone may be a product of nervous metabolism, and the cerebro-spinal fluid may be an important agent in the rapid elimination of CO_2. A number of interesting observations upon the changes of cerebro-spinal pressure relative to the arterial and venous pressures were illustrated, a full account of which is given by the authors in recent numbers of the *Journal of Physiology*.

Prof. W. A. Osborne described experiments performed by himself, and in conjunction with Mr. Basil Kilvington, in Melbourne, upon pseudo-motor action, recurrent sensibility, and central neural response. Mr. Basil Kilvington also reported an experimental method of bringing about a successful collateralisation after occlusion of the abdominal aorta, a procedure which might be useful in surgery. Dr. E. H. Embley contributed a paper upon evidence of co-ordinate action in the circulatory system.

The second day's meeting in Melbourne was begun by a general discussion upon anæsthetics. Prof. A. D. Waller demonstrated a portable apparatus for the administration of chloroform, and dwelt upon the chief dangers to be feared in anæsthesia, and upon the question as to what are the real causes of danger. Dr. E. H. Embley, whose work in Melbourne upon anæsthetics is so well known, discussed the causes and treatment of syncope, excessive intoxication, shock, and various accidental conditions. Prevention of syncope and shock he believes to be best attained by the pre-anæsthetic injection of morphine and atropine, and by the use of ether, or ether and oxygen, instead of chloroform. Dread of operation by the patient is also largely mitigated by the preliminary use of morphine. Prof. Osborne and Prof. Milroy continued the discussion, the latter describing the effect of anæsthetics upon the electro-cardiogram. Prof. R. F. C. Leith showed lantern slides of the pathological changes in a case of delayed chloroform poisoning, and Prof. Waller summed up the discussion.

Dr. J. W. Barrett then contributed an important paper upon the vision of persons engaged in navigation and railway services. He strongly advocated the thorough testing at the earliest possible time of the eyesight of all who contemplate entering either service, so that if the candidates are unsuitable rejection will take place before they have spent time and money in their training. Legislation is required for the purpose. Dr. Barrett instanced a series of accidents which were clearly due to defective vision, and which would have been avoided if a thorough examination of the sight of the men in charge had been carried out. The committee of the section passed a resolution recommending the Council of the Association to print Dr. Barrett's paper *in extenso*.

Miss Kincaid read a paper upon the biochemical significance of phosphorus, and claimed to have shown by analysis that there is a general deficiency of phosphorus in the soil and flora of Australia. Further work upon this question is to be done and reported to the Association.

Dr. S. Sewell contributed a paper upon the mechanism of micturition control in human beings.

The reports of several research committees were presented. Very little discussion of the individual contributions was possible owing to the shortness of time at disposal.

The work of the section was continued at Sydney. Sir Thomas Anderson Stewart demonstrated a number of interesting models illustrating physiological processes, *e.g.*, the functions of the corpora Arantii, the nature of sound waves in air, the action of the stapedius muscle, and the effect of simultaneous contraction of the intercostal muscles. A cyclograph, or apparatus for quickly marking microscopical slides for the identification of any part under the microscope, was also shown.

Prof. W. A. Osborne was to have opened a discussion upon climate, but as there were no other speakers on the subject he confined his observations to a consideration of the methods of taking temperature by wet-bulb thermometers. The ordinary wet-bulb thermometer is not so sensitive to changes in wind velocity as the human body, and Prof. Osborne described a method of jacketing wet-bulb thermometers so as to render them much more sensitive to changes in air currents. He also emphasised the importance of wet-bulb temperature records from a physiological point of view.

Prof. B. Moore gave the section the results of his repetition of some of the experiments of Dr. Bastian on inorganic colloids. He showed numerous slides illustrating the appearance of branching networks and hyphæ. There were no micrococci or other signs of life. Prof. Moore believes that the appearances are merely precipitation forms, the solutions are iso-electric, and give no signs of life. Considerable discussion followed, especially upon the question of infection of the solutions, and upon the methods of

determining the presence of any vital activity in them. Other communications by Prof. Moore dealt with the action of ultra-violet light upon solutions of organic substances, and with the presence of iron salts in the colourless portion of the chloroplast, and the mechanism of photo-synthesis by iron salts. Mr. Halcro Wardlaw, a science research scholar of Sydney University, described the results of a series of analyses of the deposit obtained from milk by spinning it in a centrifuge, and Dr. Burton Bradley contributed some notes on the symbiotic activities of coliform and other organisms on media containing carbohydrates.

The last day's proceedings of the section in Sydney embraced a lengthy programme, but most of the papers were taken as read, and the section thereafter joined those of chemistry and agriculture in a discussion upon metabolism. Among the subjects brought before the section, and of which abstracts were printed, were papers by Prof. T. H. Milroy on changes in the reaction of milk under different conditions as determined by the estimation of hydrogen-ion concentration by the electrometric method, and measurements of the variations of the hydrogen-ion concentration of the blood. Prof. P. T. Herring contributed papers upon the relative activity of the pars intermedia and pars nervosa of the ox pituitary, and upon the influence of the thyroid upon the activity of the suprarenals and pituitary body. In the latter communication the chief point of interest was the loss of chromaffine-substance, and corresponding diminution of activity, of the medulla of the suprarenals which rapidly follow thyroidectomy; thyroid-feeding, on the other hand, though pushed to an extreme, has no such effect. Dr. H. G. Chapman presented a paper on the freezing point of the laked red blood corpuscles of man and some domesticated animals, and Dr. C. Shellshear a paper on precipitin reactions in pathological human urines.

Several papers on psychological subjects appeared on the programme, but it was found impossible to take them. A feature of the sectional business in both Melbourne and Sydney was the large and varied contributions by local members, evincing evidence of the activity of the physiological departments in these universities.

AGRICULTURE AT THE BRITISH ASSOCIATION.

THE paramount importance of agriculture in Australia rendered the proceedings of Section M of special local interest, and the addresses and papers were arranged to deal with subjects of real significance in that country. The two addresses delivered by the president, Mr. A. D. Hall, attracted large audiences both at Adelaide and Brisbane. They were read at sessions of the whole association, and formed as valuable a contribution to Australia's needs as agricultural science and research could well have provided.

The meetings of the section at Melbourne were devoted to the subjects of irrigation, dry farming, animal breeding, and milk supply, all of which were selected in view of their importance to the Australian agriculturist. The papers on irrigation were read at a joint meeting with Section G (Engineering), and an account of the discussion has been given in the report of the proceedings of that section (November 5, p. 266).

An excellent paper by Dr. Lyman J. Briggs on dry farming investigations in the United States gave a *résumé* of the systematic work which has been carried on for many years in America on this subject. Dr. Briggs illustrated his paper with maps and diagrams, and pointed out the differences which exist between the problems in America and those in Australia. Differences in the distribution and amount of the rainfall and in the nature of the soil indicate the necessity for much investigation into the special problems of each district. A more restricted problem of special Australian interest, "The Ten-inch Line of Rainfall," was discussed by Dr. T. Cherry, who pointed out that the rainfall throughout the southern third of the continent is almost exclusively of the winter type, and that the winter temperatures are high enough to keep the ordinary cereals growing during these months. The chief problem which in this instance has now to be solved is to devise methods by which sheep and cattle can also be profitably kept on the wheat farms in the 10-in. line of rainfall, the area already having been proved very suitable for wheat.

The very high evaporation factor, which in Western Australia is four to six times greater than the rainfall, adds to the difficulty of maintaining the soil moisture. Prof. J. W. Paterson contrasted this evaporation with that in England, which is only about one-half of the annual rainfall. He also stated that the sandy soils in these dry districts are an advantage, as they are able to absorb all the rain which falls and can yield up the retained moisture more completely to the plant than more absorbent clay soils. The movement of air and water within the soil is dependent on the sizes and distribution of the free spaces between the particles, a subject dealt with by Dr. Heber Green, who spoke of the capillary power of soils and of the experiments and calculations which he had made on this subject.

Perhaps no branch of scientific research is likely to be of more direct practical value than the investigations into the laws of inheritance. In the field of animal breeding Mr. P. G. Bailey represented the Cambridge school, and reported the progress of experiments conducted on the inheritance of wool characters in a cross made between two Merino rams from Western Australia and twenty Shropshire ewes at Cambridge. He also contributed a paper on size inheritance in poultry, a subject which bids fair to yield results of practical importance to an industry which is assuming large proportions in Australia.

The improvement of the quantity and quality of milk yield has received a great impetus in late years by the keeping of milk records and the gradual elimination of the less productive cows from herds. The development of this work in England, Scotland, and Ireland was reviewed by Dr. A. Lauder. Dr. S. S. Cameron and Mr. O'Callaghan spoke of developments in this direction in Australia.

The high cost and scarcity of labour in Australia has forced the development of milking machines. Mr. Archer estimated that in Victoria alone 2000 farmers had been supplied with milking machines, and that about fourteen different makes were in use. The principal local feature is the conduit system, in which the milk is conveyed through metal pipes to a tank in the dairy, thus saving the labour of carrying the milk.

The scientific comparison of the bacteriological purity and keeping qualities of milk obtained from eleven different types of machine at trials arranged by the Royal Agricultural Society of England formed the subject of a paper by Dr. R. Stenhouse Williams, Mr. J. Golding, and Mr. J. Mackintosh. The difficulties in cleaning many of the machines, especially those fitted with long rubber tubes, is one of the chief drawbacks to their employment under existing conditions on many farms.

A visit to the State experimental farms in Australia is sufficient to show the very great importance attached to the subject of cereal breeding. Not only is a large

area of these many farms devoted to experiments on this subject; but the keen interest taken by the staffs in scientific investigation in other parts of the world and the enthusiasm in the work of William Farrer and other Australian investigators cannot fail to impress the visitor. A whole meeting at Sydney was not sufficient to exhaust the papers and discussion on cereal breeding. The papers read were as follows:—"The Migration of Reserve Material to the Seeds in Barley, considered as a Factor in Production," by Mr. E. S. Beaven; "Wheat Improvement in Australia," by Mr. F. B. Guthrie; "William Farrer's Work, Methods, and Success: a Short Sketch," by Mr. J. T. Pridham; "Wheat Breeding in Australia," by Mr. A. E. V. Richardson. Prof. Bateson, Mr. A. D. Hall, Prof. T. B. Wood and others took part in the discussion. The value of the Mendelian theory in providing a speedy and certain method for the practical man, and in directing his problems on scientific lines was illustrated by Mr. Beaven's work on barley. He showed that the ratio of the dry matter accumulated in the seed, to the total dry matter of the plant when fully ripe, frequently influences the produce of grain to a greater extent than any other factor. This "coefficient of migration" differs with different races of barley within the gross productive power which is a product of the environment.

A joint discussion with Section B (Chemistry) on metabolism, which took place at Sydney, will be reported in an article on the work of that section. Other papers contributed included "Flax as Paying Crop," by Mr. C. P. Ogilvie; "Bacterial Toxins in Soil," by Dr. Greig Smith; "The Estimation of Condition in Cattle," by Mr. J. A. Murray; "A Review of Work on Soil Inoculation," by Dr. H. B. Hutchinson, and Mr. J. Golding; and "The Effects of Caustic Lime and Chalk on Soil Fertility," by Dr. H. B. Hutchinson and Mr. K. MacLennan.

Highly satisfactory as they were, the proceedings of the section in session cannot be taken as a measure of the work achieved in 1914, for the unique advantages which members of the section gained by a visit to so rich and varied a field of agricultural endeavour cannot fail to bear fruit rich in its benefit to the science of agriculture.

It is only possible briefly to refer to the numerous and valuable agricultural excursions which were specially arranged, not only to meet the wishes of the whole section, but also to enable individual members to make independent visits to farms and districts where the branches of agriculture in which they had specialised were seen to the best advantage.

In Western Australia the latter type of excursion prevailed, and, under the personal guidance of Mr. W. Catton Grasby, Mr. J. L. Sutton, Prof. Paterson, Dr. Stoward, and Mr. A. E. Weston, visits were made to see the great developments which have recently taken place in corn growing, fruit growing, and other departments of agriculture in the great south-west area of this promising State.

From Adelaide excursions were made to Angaston, Seppeltsfield, and Tanunda. Mr. Charles Angas entertained a large party to lunch at Angaston. Vineyards and the agricultural land in the neighbourhood were afterwards visited. Roseworthy Agricultural College was the objective of a most interesting excursion from Adelaide. The instruction given to students is of a very practical nature, the buildings and laboratories are good, and the farm very well laid out in experiments on crops and stock. The introduction of Berseem (*Trifolium alexandrium*) on an irrigated plot of four acres had proved very successful, twenty-five cows having been kept on the produce of the plot for five months during the winter, the yield of green food being 36 tons per acre.

In Victoria the principal agricultural excursion was to the Central Research Farm at Werribee. Although only started in 1912, this farm of more than 1000 acres is admirably laid out in experiments on dry farming, irrigation, and live stock. The organisation was quite a model for similar institutions; a large party was conducted over it in a most thorough manner, all the experiments being ably explained by the staff and authorities from Melbourne.

From Sydney a three days' excursion was arranged which included visits to the Wagga Experiment Farm, Mr. Anthony Brunskill's 12,000 acre farm, and two days in the interesting Murrumbidgee irrigation area, including the Yanco Government Irrigation Farm and Works. Motor-cars were provided, and nights were spent in a special sleeping car.

Mr. Wade, who himself conducted the party over the irrigation area, gave a lecture and showed lantern slides and plans of this great scheme, which will provide nearly 7000 farms and support a population of 100,000 people on land which until the scheme was taken up by the Government was used as sheep runs. The famous Hawkesbury Agricultural College was also visited from Sydney, where accommodation for 200 resident students is provided; the farm comprises some 3440 acres of land. All branches of farming, especially the orchard, dairy, piggery, and poultry farm, were well worth a visit.

The cultivation of sugar cane and a sugar mill in full work was inspected at Nambour, Queensland, by a large party, and opportunities were afforded for smaller parties to see the work on the eradication of the prickly-pear, and to visit large sheep farms, etc.

The most striking feature in the visits to experimental farms in most parts of Australia was the response shown by the crops to phosphatic manures, even when, as is the practice, very small dressings were applied with the combined manure and seed drill. In one case in Western Australia 30 lb. of superphosphate added per acre had doubled the yield of wheat (9 bushels raised to 18). Sixty to 80 lb. of superphosphate per acre were commonly used in this excellent drill.

The section met with the greatest kindness and hospitality on all sides, and it is invidious to particularise amongst such a number of generous and indefatigable hosts, but special thanks are due to Mr. W. Hutchinson, Minister of Agriculture for Victoria, Dr. Cameron, Dr. Cherry, and Mr. Richardson, of Melbourne, and to Prof. R. D. Watt, of Sydney, for the part they took in carrying out the many and valuable excursions

BUDGETS AND STUDENTS OF UNIVERSITIES AND UNIVERSITY COLLEGES IN RECEIPT OF STATE GRANTS.

THE reports for the year 1912–13 from those universities and university colleges in Great Britain which are in receipt of grant from the Board of Education have been published in two Blue-books (Cd. 7614 and Cd. 7615). The tabular matter, which precedes the separate reports from the places of higher education dealt with, contains detailed information as to the income and expenditure of the various institutions concerned. The following summaries have been compiled from the tables, and make clear the amount available for higher education and research in the universities and university colleges receiving Treasury grants, and how the income is expended.

UNIVERSITIES AND UNIVERSITY COLLEGES.

(1) ENGLAND.

(*a*) *Income.*

	Amount £	Percentage of total
Fees	183,880	27·8
Endowments	95,045	14·4
Donations and subscriptions	22,381	3·4
Annual grants from local authorities	103,650	15·7
Parliamentary grants ...	232,821	35·2
Contributions from hospitals, etc., for services rendered	2,338	0·4
Other income	20,486	3·1
	660,601	

(*b*) *Expenditure.*

Administration	68,329	10·3
Maintenance of premises	68,670	10·4
Educational expenses ...	425,515	64·3
Superannuation	22,840	3·4
Other expenditure in respect of maintenance ...	30,219	4·6
Expenditure not in respect of maintenance ...	46,288	7·0
	661,861	

(2) WALES.

(*a*) *Income.*

	Amount £	Percentage of total
Fees	17,456	27·7
Endowments	4,448	7·1
Donations and subscriptions	2,330	3·7
Annual grants from local authorities	3,441	5·5
Parliamentary grants ...	34,217	54·3
Other income	1,132	1·7
	63,024	

(*b*) *Expenditure.*

Administration	8,020	11·8
Maintenance of premises	4,597	6·8
Educational expenses ...	48,232	71·0
Superannuation	1,733	2·5
Other expenditure in respect of maintenance ...	497	0·7
Expenditure not in respect of maintenance ...	4,891	7·2
Total	£67,970	

On comparing the statistics with those of the previous year, it is noticed that in England the total income of the institutions has risen by 38,000*l.*, which is made up as follows: the fee income has risen by 3000*l.*, the income from endowment by more than 9000*l.*, that from local authority grants by nearly 8000*l.*, while Parliamentary grants supplied nearly 18,000*l.* additional assistance, though part of the income from this last-mentioned source, is derived from grants which are referable to previous years.

Certain individual figures are interesting. Manchester University has an income from endowment of rather more than 22,500*l.*, and Liverpool University one of nearly 15,000*l.* Reading University College has an endowment income of practically 9000*l.*, which represents more than 31 per cent. of its total revenue. The largest proportions of income derived from grants from local authorities are found at the University Colleges of Southampton and Nottingham, in both of which cases nearly 40 per cent. of the income is provided from this source. Similarly, 29 per cent. of the income of Sheffield University is obtained from grants from local authorities.

The total expenditure in England has risen by nearly 60,000*l.* Nearly 4000*l.* of this increase is accounted for by administration, nearly 5000*l.* by cost of maintenance of premises, rates, etc., and more than 30,000*l.* by expenditure on teaching salaries and equipment. More than 9000*l.* additional expenditure was incurred on superannuation provision, for which increased grants have recently been made. Seven per cent. of the total expenditure at all institutions was made in respect of charges of a non-maintenance character. The highest percentages for these charges are at Sheffield, 18·5 per cent.; Birmingham, 14 per cent.; King's College for Women, 12·3 per cent.; and Bedford College, 10·2 per cent.

A new table indicates the amount of grant aid given to university institutions under the provisions of the "Statements of grants available from the Board of Education in aid of technological and professional work in universities in England and Wales" in the financial years 1912–13 and 1913–14. The total amount of grant aid under these provisions rose from 41,647*l.* in the financial year 1912–13 to 44,623*l.* in 1913–14. The total amount of Exchequer grants in England in aid for universities and university colleges in the year 1912–13 was 170,000*l.*, and, in addition, 31,000*l.* was paid to university colleges in Wales.

In addition to the financial statistics, the reports contain much useful information concerning the number of students in the various colleges, their ages, the subjects they are studying, and so on; and the following tabular statements will serve to summarise them. It is necessary to point out that the numbers concern only the following institutions:—The Universities of Birmingham, Bristol, Durham (Armstrong College), Leeds, Liverpool, Manchester, Sheffield, London (including University College, King's College, Bedford College, School of Economics, and East London College), and also the University Colleges of Nottingham, Reading, and Southampton. The University of Wales includes the University Colleges of Aberystwyth, Bangor, and Cardiff.

NUMBER OF FULL-TIME STUDENTS.

	England	Wales
Degree Students:—		
Training college	1397	420
Others	3402	648
Total	4799	1068
Non-graduate (diploma) students:—		
Training college	644	8
Others	1113	98
Total	1757	106
Post-graduate students:—		
Training college	29	—
Others	479	76
Total	508	76
Other courses	602	39
Total	7666	1289

NUMBER OF PART-TIME STUDENTS.

Day.

	England	Wales
Degree	229	4
Non-graduate (diploma) ...	182	29
Other courses	3406	297
Post-graduate	1023	19
Carried forward ...	4840	349

Brought forward (*Day*)	4840	349
Evening.		
Degree	363	—
Non-graduate	764	—
Other courses	7576	—
Post-graduate	255	—
Total	13,798	349

In England the total number of full-time students at these institutions of higher education in 1912–13 was 7666, as compared with 7827, in the previous year. The total number of part-time students has, on the other hand, increased from 13,348 to 13,798. The fall in the total number of full-time students is due to a decrease of fifty-six in the number of training college students and of 105 other students, making 161 in all. The number of full-time post-graduate students has risen by fifty-four, and the number of full-time diploma students by 103. On the other hand, there has been a fall of 159 in the number of students reading for degrees, and another of 159 in the number of students of undergraduate standing who were not reading for a degree.

It would appear, the report points out, that the rate of increase in the number of full-time students has been diminishing for some years past. The position is not satisfactory from the wider national point of view. There is little doubt that the commercial prosperity of the country during recent years has had a good deal to do with this diminution in the number of students who are seeking a university education. Furthermore, the bulk of the parents of the boys and girls in the State-aided secondary schools of the country have little sense of the value of a university education. Only a minority of these schools send students to the universities unless they happen to be placed in or very near to the university towns. It is not suggested that it would benefit all boys to go to a university without regard to their means or their ability and without a careful selection of their course of study, but there are grounds for thinking that the demand for healthy and able young men with a university training is beginning to outrun the supply. The openings for administrators of various kinds and for teachers in the Indian Empire and in the Crown Colonies are increasing in number, while suitable candidates are not. Nor is the demand confined to service abroad.

The Royal Commissioners on the Civil Service are evidently of opinion that the newer universities are not contributing a due proportion of candidates for the Home Services. "We should be glad," they say, "to see the Scottish, the Irish, and the young English and Welsh universities assert more vigorously their claim to share in Civil Service appointments." That they have not done so in the past is in part due, no doubt, to the character of the examination, but it is largely explained by the younger age at which their students graduate—in itself evidence of a hurried education—and partly by the diversion of some of the brightest minds in the schools to the practical world of business before the secondary stage of their education is complete. It is doubtful whether even the commerce of the country will benefit in the long run by this impatience; it is certain that the national and Imperial Services lose the variety of training and upbringing which is to be desired in their recruits.

By comparing the figures in England for 1911–12 with those for 1912–13 the following statistics are obtained :—

STUDENTS IN VARIOUS FACULTIES.

	1911–12	1912–13
Arts	3529 ..	3405
Science ...	1726 ...	1704
Medicine ...	2597 ...	2697
Engineering ...	1105 ...	1059
Technology ...	347 ...	361
Agriculture ...	186 ...	206

This table shows the number of full-time students in all institutions coming within the scope of the report, arranged according to the faculties in which they are studying.

It will be noticed that the fall in students which has been previously mentioned is confined to the faculties of arts, science, and engineering. The greatest actual fall is in the arts faculty, but the relative fall is equally great in the faculty of engineering. In the faculties of medicine, agriculture, and technology there has been an increase.

AGE OF ADMISSION OF FULL-TIME STUDENTS. (1912–13.)

	England	Wales
Number admitted	3241	371
Percentage under 17	4·9	1·6
Percentage 17–18	12·7	8·9
Percentage 18–19	24·5	32·3
Percentage above 19	57·9	57·2

It should be pointed out that the number of students under England in this table includes 257 students at the nine medical schools of the University of London, and forty-two students at the College of Medicine, which is a constituent college of the University of Durham.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The University has offered academic hospitality to accredited teachers and students of Belgian universities who have taken refuge in Glasgow. The heads of the several departments will afford them such facilities for study and research as it may be found practicable to provide.

The bequest of some 12,000*l.*, left for the department of naval architecture under the will of the late Dr. Francis Elgar, has now accrued to the University. An equal amount is bequeathed to the Institution of Naval Architects.

Mr. S. Mavor, of Glasgow, has presented to the geological department a collection of more than 500 specimens, illustrative of the coal-beds of Great Britain and the continent of Europe.

Mr. A. Fleck, formerly demonstrator to Prof. Soddy, has been appointed physical chemist to the Glasgow Radium Committee, established to administer a large fund collected in the city for the purpose of acquiring and distributing radium for therapeutic purposes. A radiometric laboratory, under the auspices of the committee, has been fitted up at the University.

IT is known that there are many Belgian medical graduates refugees in this country who may find it difficult to obtain suitable accommodation. To meet this need the committee of the London School of Tropical Medicine will be pleased to hear from Belgian medical men who may desire to avail themselves of the hospitality of the school to the extent of board and residence in the hostel attached thereto. The Committee also invites any graduate so resident to attend the various classes while the school is in session.

THE first meeting of the re-constituted Agricultural (previously Rural) Education Conference was held on Tuesday, November 10, Lord Barnard being in the chair. The conference appointed a committee, composed partly of its own members and partly of women co-opted for the special purpose, to consider the following reference received from the Board of Agriculture and Fisheries: "To consider the provision made in England and Wales for the agricultural education of female students of sixteen years of age and upwards, and to report whether the existing facilities are sufficient, and if not, to what extent and in what direction these should be developed and improved."

TEACHERS of domestic subjects in schools and colleges who desire to give their instruction a scientific character continually find that some of the commonest observations and methods of domestic work are very difficult to explain. To assist such teachers to arrive at satisfactory explanations of the various steps in common domestic practice, the Association of Teachers of Domestic Subjects has appointed a science committee to which problems that arise may be referred for elucidation or investigation. Prof. Smithells is chairman of the committee, which includes several well-known chemists as well as practical teachers of domestic subjects. The report of this committee for 1914, which has been received, contains abundant evidence of the utility of the work of the committee, and every teacher of domestic subjects should study the answers to the questions discussed in it.

THOUGH the University of Bristol is one of the youngest of English universities its calendar for 1914–15, a copy of which has been received, shows that it is making rapid strides in the direction of providing a very complete system of higher education for the western counties of England. There are in the University faculties of arts, science, medicine, and engineering. We observe, among other interesting arrangements, that an alternative curriculum is provided so that undergraduates pursuing the study of agriculture and forestry may take an ordinary bachelor of science degree. Regulations are included by which students may secure the degree of bachelor of science in engineering by research. Those students who are not qualified by matriculation to proceed to a degree, may in certain circumstances procure a certificate in engineering. The University also, we notice, confers testamurs in social science and journalism. Among institutions associated with the University may be mentioned the Royal Agricultural College at Cirencester, the National Fruit and Cider Institute at Long Ashton, and the Agricultural and Horticultural Station at Long Ashton.

THERE is a tendency among popular philosophers and supernaturalists just now to suggest that modern science is crude materialism against which a spiritual reaction is to be encouraged. Some justification might have been found for such a view a generation or two ago, but the dogmatism of those days, both of men of science and theologians, has given way to a more liberal spirit, and all who are seeking earnestly for truth are considered to be worshippers at the same shrine. We are glad, therefore, to direct attention to a series of addresses upon the mutual relations between science and religion to be delivered by scientific men of distinction at Browning Hall, Walworth Road, S.E., during the week beginning on Sunday next, November 22. The addresses are intended for working men and women, students and teachers, and they will be delivered by Sir Oliver Lodge, Prof. J. A. Fleming, Prof. W. B. Bottomley, Prof. E. Hull, Dr. J. A. Harker, Prof. Sims Woodhead, and Prof. Silvanus Thompson; all seats will be free. There is, of course, no conflict between religion and science; one is the expression of an instinct, the other is a spirit of inquiry into the character and meaning of all things, visible and invisible, in the universe. It is particularly important at the present time to show that science is an uplifting study, and not merely the handmaid of material advance. Ruskin described the difference between science and invention long ago, but it is forgotten by most writers, and we trust that the addresses to be given at Browning Hall will do something to remove mistaken popular impressions as to the aim and meaning of scientific work.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, November 4.—Dr. A. Smith Woodward, president, in the chair.—L. **Richardson**: The inferior oolite and contiguous deposits of the Doulting-Milborne-Port District (Somerset). This paper embraces the country around Bruton, Castle Cary, and Blackford. In the northern half of the Doulting-Milborne-Port district the bulk of the yellow Upper-Lias Sands is of *dispansi* hemera; but in the neighbourhood of Cole and Castle Cary the topmost portion is of *dumortieriae* hemera. In the south-eastern portion, under Stowell, while the main mass is probably of *moorei-dumortieriae* hemeræ, the upper 50 ft. is of *aalensis-moorei* date. Rock of *garantianae* hemera spreads over the whole district. From Doulting to Bruton the Garantiana beds rest directly on the Sands. In the neighbourhood of Cole there is a synclinal area, and beds of *blagdeni, sauzei, witchelliae, shirbuirniae, discitae,* and *murchisonae* hemeræ are seen between the Garantiana beds and the Sands. At Corton Downs are rocks of *sauzei, witchelliae, shirbuirniae, discitae, bradfordensis,* and *murchisonae* hemeræ. In this southern portion of the district it is difficult to determine the upper and lower limits of the deposits of *discitae, shirbuirniae,* and *witchelliae* hemeræ. The rock of *garantianae* hemera varies much from place to place in thickness and lithic structure. Above the Garantiana beds come the Doulting Stone, Anabacia Limestones, and Rubbly beds. The Anabacia Limestones soon lose their lithic characters; but the Doulting Stone spreads over the Oolitic tract, and is exposed in numerous quarries. In the southern portion of the district, the lower portion of the equivalent of the Hadspen Stone passes into the Sherborne Building-Stone, and the top portion, *plus* higher beds, into the Rubbly Limestone beds, such as those displayed in quarries in the eastern portion of the Sherborne district.—E. T. **Paris** and L. **Richardson**: Some Inferior-Oolite pectens. Descriptions and illustrations are given of one new species of Camptonectes, of two new varieties of *Chlamys articulata* (auctt.), and of two new species of Velopecten.

Linnean Society, November 5.—Prof. E. B. Poulton, president, in the chair.—A. D. **Cotton**: The algæ, lichens, and fungi of the West Falkland Islands, from Mrs. Rupert Vallentin's collections. A large collection was made by Mrs. Vallentin from 1909 to 1911, and was presented by her to the Royal Botanic Gardens, Kew; the present paper dealt with those Cryptogams mentioned in the title, the Mosses and Hepaticæ being reserved for later work. These collections are valuable and have yielded interesting results, including several novelties, and many additions to the flora, and by means of ample, well-dried material, enabled previous descriptions to be enlarged and revised. The author gave an historical account of the cellular Cryptogams from the earliest record (1771) to the present time, and included in his list all previous records, revised so far as practicable.

Mathematical Society, November 12.—Annual general meeting.—Prof. A. E. H. Love (retiring president) and afterwards Sir Joseph Larmor (newly-elected president) in the chair.—Prof. **Love**: Presidential address, "Mathematical Research." Prof. G. A. **Miller**: Note on an extension of Sylow's theorem.—J. **Hodgkinson**: The conformal representation of the various triangles bounded by the arcs of three intersecting circles.—G. R. **Goldsbrough**: The dynamical theory of the tides in a zonal basin.—G. H. **Hardy**: The modulus of an analytic function.—Prof. W. **Burnside**: (i) The modification of a train of waves as it advances into

shallow water. (ii) A configuration of 21 points and 21 lines which arises from the complete quadrilateral and determines the group of 168 plane collineations.—Prof. Tadahiko **Kubota**: Convex closed surfaces.—Prof. W. H. **Young**: Integrals and derivates with regard to a function.

Mineralogical Society, November 10.—Anniversary meeting.—Dr. A. E. H. Tutton, president, in the chair.—Prof. W. J. **Lewis**: Albite; its crystal elements, etc. New values of the elements were obtained based upon measurements made on well-developed twinned crystals from Alp Rischuna. Chemical analysis showed them to be very pure albite.—H. **Collingridge**: The determination of the maximum extinction angle, optic axial angle, and birefringence of monoclinic pyroxenes in thin sections. The method depends on the presence of well-defined twins about 100, and the visibility of an optic axis through one individual. From observations in this individual of the positions of the trace of the optic axial plane and the twin plane, the extinction angle, and the position of the visible optic axis, and in the other the extinction angle and the birefringence, and, if possible, the positions of an optic axis and the trace of the optic axial plane, the requisite determinations may be made.—Prof. H. L. **Bowman**: Note on calcite from the Chalk at Corfe Castle, Dorset. Good crystals, which occur in veins in the Upper Chalk, are of the pointed habit, the forms being f (11$\bar{1}$) and x (21$\bar{2}$). Interpenetrant rhombohedra twinned about the c axis, as in cinnabar, are not uncommon.—A. **Scott**: Barkevikite from Lugar, Ayrshire, and litharge from Persia. The former occurs in lugarite in prismatic crystals up to 75 mm. in length, with mean refractivity 1·690, and very intense pleochromism, c very dark brown, b reddish-brown, a light yellow; in chemical composition it is fairly close to the type mineral from Barkevik. The latter was found at Larshuran, Persia, as a red mica-like crystalline mass; it is biaxial with mean refractivity 1·735, the double refraction being very weak, and contains more than 97 per cent. of lead oxide, the remainder being copper oxide with a little antimony oxide.—Dr. G. T. **Prior**: The meteorites of Uwet, Kota Kota, and Angela; the identity of Angela and La Primitiva. The meteoric iron of Uwet, Southern Nigeria, said by natives to have fallen about ninety years ago, is a hexahedrite of the Braunau type, containing about 6 per cent. of nickel. The meteoric stone of Kota Kota, Marimba district, British Central Africa, said by natives to have been seen to fall some years ago, is a chondrite, probably belonging to the crystalline spherulitic group. The meteoritic iron of Angela, near Iquique, Chili, was found in the nitrate beds. It is an ataxite, containing about 4·5 per cent. of nickel, and enclosing large nodules of schreibersite, and is probably identical with La Primitiva.

EDINBURGH.

Royal Society, November 2.—Prof. James Geikie, president, in the chair.—Sir William **Turner**: The Baleen whales of the South Atlantic. The paper was essentially a comparison of certain anatomical characteristics of specimens of whales recently found in the South Atlantic with those of the better known whales of the North Atlantic. The conclusion was that of the Balænopteridæ, five species were common to the north and south Atlantic oceans, namely, *Megaptera boops* (*longimana*), and the four species of *Balaenoptera, sibbaldi, borealis, rostrata, musculus*. Similarly the smaller right whale, *Balaena australis*, which frequents the temperate waters of the South Atlantic, is obviously the same species as the *Balaena biscayensis* of the North Atlantic. On the other hand, *Balaena mysticetus* of the Arctic Ocean appears to have no representative in the Antarctic.—Dr. J. E. **Mackenzie** and S. **Ghosh**: The optical rotation and cryoscopic behaviour of sugars dissolved in (1) formamide, (2) water. The mutarotation of the sugars, β-*l*-arabinose, *l*-xylose, α-*d*-glucose, α-*d*-galactose, *d*-mannose, *d*-fructose, α- and β-lactose, dissolved in the solvents named, was measured and found to be of the same character. The molecular weights of the same sugars dissolved in these solvents were also determined, and each sugar was found to be in the monomolecular state. The results of the optical rotation measurements in formamide, like those obtained in pyridine solution by Grossmann and Bloch, appear to show that the presence of water is not essential to explain the phenomenon of mutarotation of sugars.

PARIS.

Academy of Sciences, November 3.—M.P. Appell in the chair.—A. **Lacroix**: The products of alteration of aluminium silicate rocks, and, in particular, the laterites of Madagascar.—G. **Lippmann**: The Hughes electromagnetic balance and its application to medical surgery (see p. 319).—D. **Eginitis**: Observation of the solar eclipse of August 21, 1914, made at the Athens Observatory with the Doridis equatorial (Gautier, 40 cm.). Particulars are given of actinometric observations, and of measurements of air temperatures, relative humidity, barometric pressure, and wind velocity.—M. **Guéritot**: An experimental method of determining the metacentric curves of an aeroplane. Details of experiments made on a model fixed to a float in water.—J. **Bougault**: The dioxytriazines. The reaction between the semicarbazides of α-ketonic acids and aqueous soda solution takes place in the cold. The yield is better than when the experiment is carried out at the boiling point, but the reaction velocity is very slow. The dioxytriazines react with sodium hypobromite, giving substituted amides of the type $R.CBr_2.CO.NH_2$.—G. A. **Le Roy**: The waterproofing of military clothes. The whole garment is impregnated with lanoline, by immersion in a solution in a volatile solvent containing from 5 per cent. to 10 per cent. of the wool fat. The cloth remains permeable to air, but is impermeable to water.—Marcel **Baudouin**: The ossification of the metacarpal and metatarsal bones in men of the polished Stone age.

BOOKS RECEIVED.

College Physiography. By Prof. R. S. Tarr. Published under the editorial direction of Prof. L. Martin. Pp. xxii+837. (London: Macmillan and Co., Ltd.) 15*s*. net.

A Handbook of Vocational Education. By Dr. J S. Taylor. Pp. xvi+225. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*. net.

A Text-Book of Grasses. By A. S. Hitchcock. Pp. xvii+276. (London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

The Royal Zoological and Acclimatisation Society of Victoria. Fiftieth Annual Report. Pp. 43. (Melbourne.)

New Zealand. Department of Lands and Survey. Report on the Survey Operations for the Year 1913–14. By E. A. Wilmot. Pp. 55+maps. (Wellington: J. Mackay.)

The Essex Institute. Historical collections. Vol. i. October. Pp. 289–404. (Salem, Mass.: Essex Institute.)

Some South Indian Insects and other Animals of Importance. By T. B. Fletcher. Pp. xxii+565. (Madras: Government Press.) 9*s*.

Vital Statistics Explained. By J. Burn. Pp. x+140. (London: Constable and Co., Ltd.) 4*s*. net.

A Study of the Circular Arc Bow-Girder. By Prof. A. H. Gibson and E. G. Ritchie. Pp. viii+80. (London: Constable and Co., Ltd.) 10s. 6d. net

Imperial Department of Agriculture for the West Indies. Report on the Botanic and Experiment Station, Montserrat, 1913–14. Pp. 26. (Barbados.)

Reptiles and Batrachians. By E. G. Boulenger. Pp. xiv+278. (London: J. M. Dent and Sons, Ltd.) 16s. net.

Proceedings of the Liverpool Geological Society. Session the fifty-fifth. 1913–14. Part 1. Vol. xii. Pp. xiv+92. (Liverpool: Liverpool Geological Society.)

The Musical Faculty: its Origins and Processes. By W. Wallace. Pp. viii+228. (London: Macmillan and Co., Ltd.) 5s. net.

The Elements of Physical Chemistry. By Prof. J. L. R. Morgan. Fifth edition. Pp. xv+506. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12s. 6d. net.

A Handbook for Farmers and Dairymen. By Prof. F. W. Woll and others. Sixth edition. Pp. xvi+490. (New York: J. Wiley and Sons, Ltd.; London: Chapman and Hall, Ltd.) 6s. 6d. net.

Philosophical Transactions of the Royal Society of London. Series B. Vol. ccv. Experiments on Inheritance in Parthenogenesis. By W. E. Agar. Pp. 421–489. (London: Royal Society.)

Our Good Slave—Electricity. By C. R. Gibson. Pp. 246. (London: Seeley, Service and Co., Ltd.) 3s. 6d.

The Great Ball on which we Live. By C. R. Gibson. Pp. 249. (London: Seeley, Service and Co., Ltd.) 3s. 6d.

A First Course in Mathematics for Technical Students. By P. J. Haler and A. H. Stuart. Pp. vi+125. (London: University Tutorial Press, Ltd.) 1s. 6d.

Proceedings of the Aristotelian Society. New Series. Vol. xiv. Pp. 438. (London: Williams and Norgate.) 10s. 6d. net.

The Analysis of Sensations and the Relation of the Physical to the Psychical. By Dr. E. Mach. Translated by C. M. Williams. Revised and supplemented by S. Waterlow. Pp. xv+380. (Chicago and London: The Open Court Publishing Co.) 6s. 6d. net.

Essays on the Life and Work of Newton. By A. de Morgan. Edited by P. E. B. Jourdain. Pp. xiii+108. (Chicago and London: The Open Court Publishing Co.) 5s. net.

Trees and Shrubs Hardy in the British Isles. By W. J. Bean. Vol. i. Pp. xvi+688. Vol. ii. Pp. vi+736. (London: John Murray.) 42s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 19.

ROYAL SOCIETY, at 4.30.—Note on the Circulation of the Atmosphere: A. Mallock.—The Origin of the Indo-Gangetic Trough—commonly called the Himalayan Foredeep: Sir S. Burrard.—Approximately Permanent Electronic Orbits and the Origin of Spectral Series: G. W. Walker.—Spectroscopic Investigations in connexion with the Active Modification of Nitrogen. IV.: A Band Spectrum of Boron Nitride: W. Jevons.—An Additional Note on the Production of High Permeability in Iron: Prof. E. Wilson.

CHILD STUDY SOCIETY, at 7.30.—Development of the Practical Imagination in Children: Prof. T. P. Nunn.

LINNEAN SOCIETY, at 8.—*Hydrilla verticillata*, Casparv, a New British Plant: A. J. Wilmott.—The Mosses and Hepaticæ of West Falkland Islands, from the Collections of Mrs. Rupert Vallentin: C. H. Wright.—The Thysanoptera of the West Indies: R. S. Bagnall.

INSTITUTION OF MINING AND METALLURGY, at 8.—Persistence of Ore in Depth: T. A. Rickard.

FRIDAY, NOVEMBER 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Effect of Vacuum on Steam-Turbines: G. G. Stoney.

MONDAY, NOVEMBER 23.

FARADAY SOCIETY, at 8.—Discussion: The Hardening of Metals. Introductory Address: Sir Robert Hadfield.—Some Recent Papers on Hardening and Overstrain in Metals, and the Bearing on these of the Author's Amorphous Theory of the Hardened State: Dr. G. T. Beilby.—The Influence of Allotropy on the Metastability of Metals and its Bearing on Chemistry, Physics, and Technics: Prof. E. Cohen.—The Hardening of Metals by Quenching: Prof. C. A. Edwards.—The Interstrain Theory of Hardening: Andrew McCance.—The Part Played by the Amorphous Phase in the Hardening of Steels: J. C. W. Humfrey.—(1) The Hardness of Solid Solutions; (2) A Note on Twinnings and the Martensitic Structure: Dr. C. H. Desch.—Metallic Filings: Dr. T. Martin Lowry and R. G. Parker.—The Hardening of Manganese Steel: Prof. H. M. Howe and A. G. Levy.—Instruments for Testing Hardness: H. L. Heathcote.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Mental Training of a Traveller: Viscount Bryce.

ROYAL SOCIETY OF ARTS, at 8.—The History and Practice of the Art of Printing: R. A. Peddie.

TUESDAY, NOVEMBER 24.

ZOOLOGICAL SOCIETY, at 5.30.—Exhibition of Tests of Arenaceous Foraminifera to Introduce a Discussion on the Interpretation of these Structures: E. Heron-Allen and A. Earland.—(1) A New Fossil Reptile from South Africa; (2) Notes from Some Carnivorous Therapsids; (3) *Eunotosaurus africanus*, Seeley, and the Ancestry of the Chelonia: D. M. S. Watson.—Polychæta from the N.E. Pacific: The Chætopteridæ. With an Account of the Phenomenon of Asexual Reproduction in Phyllochætopterus and the Description of Two New Species of Chætopteridæ from the Atlantic: F. A. Potts.

WEDNESDAY, NOVEMBER 25.

ROYAL SOCIETY OF ARTS, at 8.—The Supply of Chemicals to Great Britain and Her Dependencies: Sir W. A. Tilden.

THURSDAY, NOVEMBER 26.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Power Plant Testing: W. M. Selvey.

PHYSICAL SOCIETY, at 5.—Note on the Conduction of Electricity at Point Contacts: A. F. Hallimond.—Thermal Conductivity of Badly Conducting Solids: T. Barratt.

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